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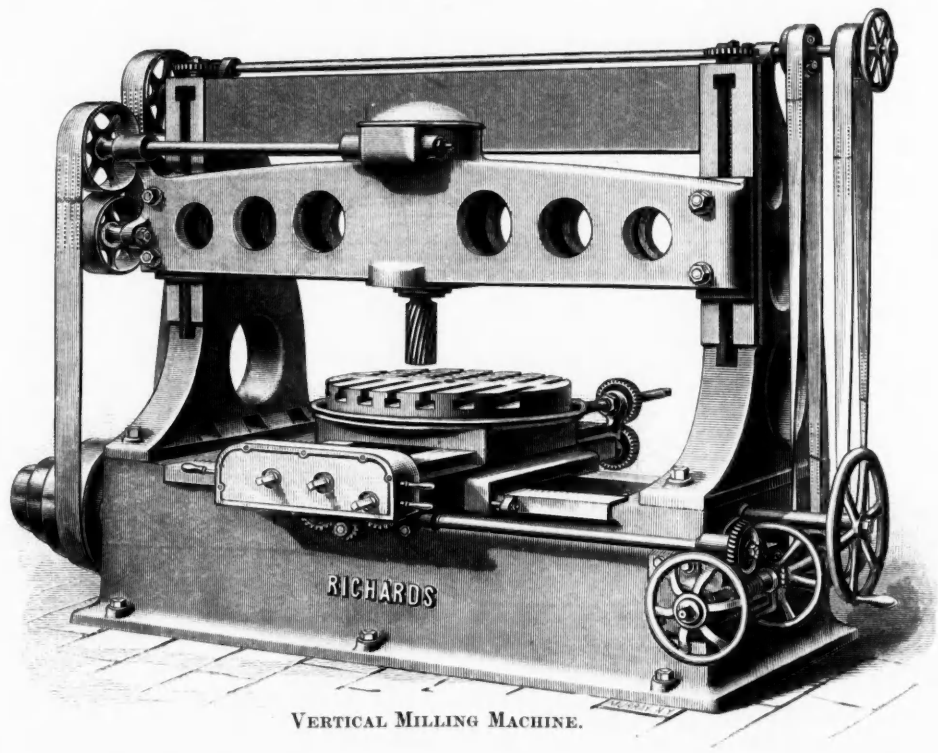
## Vertical Milling Machine.

The engravings on this and pages 2 and 3 are of a heavy upright milling machine, which represents the most recent and advanced English practice, in that line of machine tool building. In general design it will be perceived that the machine resembles our American boring mills, except that the housings are not so high in proportion to the breadth of the machine; the movable saddle is replaced by a fixed support and bearing for the main spindle at the center of the cross-rail and a platen is provided, which has all the motions of a slotting machine table, *i. e.*, it can be rotated automatically or by hand, or can be given motion laterally along the bed or from front to back; all these motions being controlled or produced from a position directly in front of the work. The housings, besides being heavily proportioned, are thrown forward at the bottom to give them increased support and rigidity, while the shape of the cross-rail is such that the main spindle is thrown out only 3 inches from the line joining their faces.




VERTICAL MILLING MACHINE.

Motion is taken from the countershaft to the cone pulley at the left, from whence a belt passes over a pulley above, which drives a shaft mounted on the cross-rail and at the other end of which is a worm engaging with a worm-wheel on the main spindle, by which the latter is driven. The belt passes over two idler pulleys, one attached to the housing and the other to the cross-rail, so that uniform belt tension is secured for all positions of the rail. The shaft to which the cone pulley is secured passes through the bed, and at the other extremity has fitted to it a friction disk designated "No. 32," on the detail views Figs. 1, 2 and 4. From this friction disk all the feed motions are derived, their rate being governed by the position of a friction wheel mounted upon a splined shaft which passes along the end of the bed and carries at one end a worm which engages with a worm-wheel at the end of the feed-rod which passes along the bed on the side next the operator. This feed-rod is splined, and by means of bevel gears imparts motion to the train of gears in the apron from which the various feed motions are derived. The other end of the transverse shaft carries two pulleys from which quarter-turn belts lead up to a shaft which passes across the top of the machine from one housing to the other, and by means of worm gearing and screws raises or lowers the cross-rail.

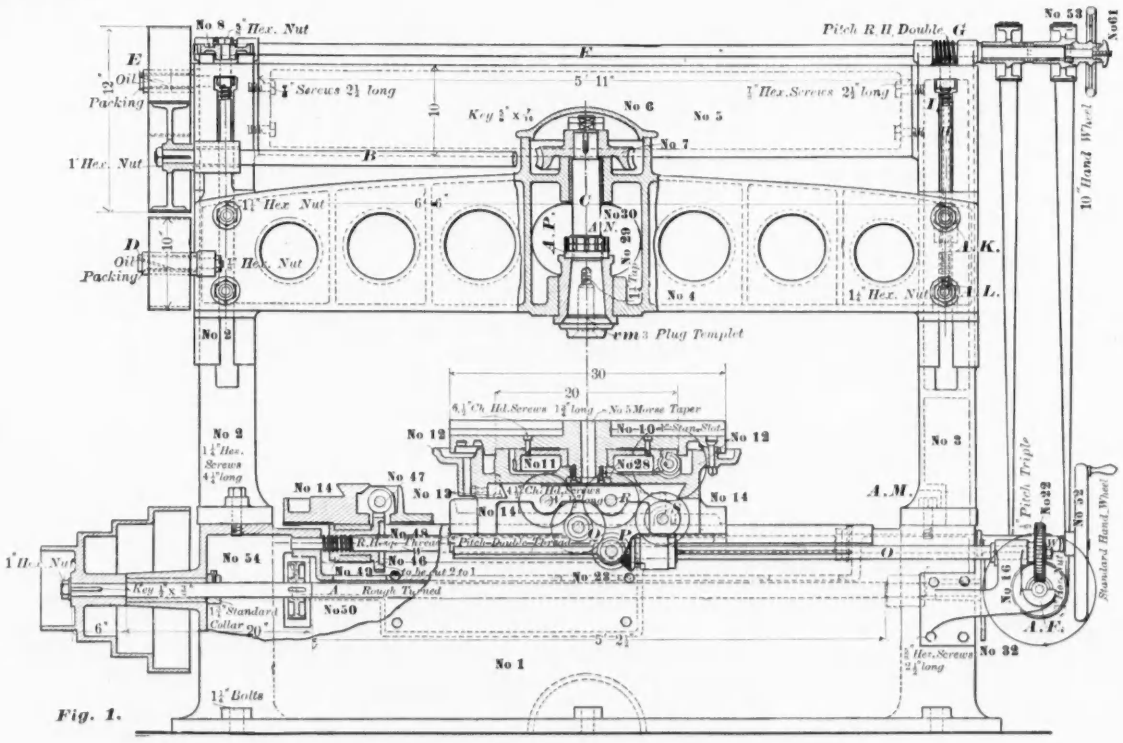



*Fig. 1.*

By means of the hand-wheel (No. 21, Figs. 2 and 4,) the friction-wheel is moved across the face of the friction disk, to vary the rate or change the direction of the feed, this hand-wheel being threaded to fit the stationary screw on which it is mounted, so that, as it is turned, it travels in or out, and by means of the connection (No. 20) changes the position of the friction-wheel on the disk. Longitudinal movement of the platen on the bed may be effected by hand in two different ways, and from two different positions. A large screw passes through the center of the bed under the saddle, having at its outer end the large hand-wheel (No. 52, Figs. 1 and 4), by which it may be turned, the nut through which it works being really a spiral gear attached to the saddle, in the manner shown in Fig. 3 at W. This spiral gear engages with a similar gear on the end of a shaft, which is at right angles to the screw, and passes through to the front of the machine, where its outer end is squared for the reception of a crank handle, by which it can be rotated. This shaft is at the left of the apron in the general view, and is the upper one of the three similar ones in the plan, Fig. 2. It is driven by gearing in the apron, to which it can be connected or disconnected by a clutch controlled by the lever at the left of the apron. The large screw ordinarily stands still, the feed being obtained from the motion of the threaded spiral gear upon it; but at any time, whether the feed be in operation or not, the screw can be turned by the hand-wheel at the end of the machine.

The middle one of the squared ends is the cross-feed screw as shown by Figs. 2 and 4, its motion being controlled by the upper one of the two levers seen at the right of the apron.

The remaining square is on the end of a shaft, which passes through to the back of the machine, and by means of the two spur gears (Nos. 42 and 43, Fig. 3,) drives a splined shaft, which is parallel with and above it, and at the inner end of which is a worm that engages with the large worm-wheel (No. 11, Fig. 1,) by which rotary motion is imparted to the platen.

Water or other lubricant which may be used on cutters is returned to the tank (No. 45, Fig. 3,) from whence it is forced by a rotary pump directly to the cutter or to a suitable tank above it. The worm and wheel which drive the cutter spindle are thoroughly protected from dust and dirt, yet are readily accessible by simply lifting the cover which is over them, and, as the section through the center of the spindle shows, the form of bearings and the means for taking up wear and preserving alignment are of the most approved character.

All the principal dimensions are given in figures in the detail views, a study of which will, we believe, lead to the conclusion that the machine may be considered a very creditable example of machine tool designing.

The builders are Geo. Richards & Co., Broadheath, near Manchester, England.

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One of the absurdities of municipal management comes to the front in New York, in the instance of the Pennsylvania Railroad. This railroad makes its connection between Jersey City and New York by means of ferries. Those patronizing the ferries must cross West street, which thoroughfare is usually nearly in a condition of blockade, from the great number of heavily loaded trucks and street cars passing. The rush of passengers from the Cortlandt street ferry often blocks West street, causing delay and inconvenience to the passengers on street cars, and to the other traffic on the street. The ferry passengers are also inconvenienced, and their lives endangered by the passing trucks and other vehicles. The Pennsylvania Railroad, with a view to provide for the comfort and safety of its ferry passengers, proposes to bridge West street, a measure which would undoubtedly help the company, but not to the extent that it would help those who cross by the ferry to and from New York and Jersey City, and the citizens of New York whose business leads to trucking and traveling along West street. Here the controlling powers in New York step in and say, in effect, to the Pennsylvania Company: We shall fine you if you undertake to benefit our city. And a very comfortable sum indeed is wanted for the privilege. There may be more silly things than fining a corporation for benefiting a city, but just now we cannot recall them.

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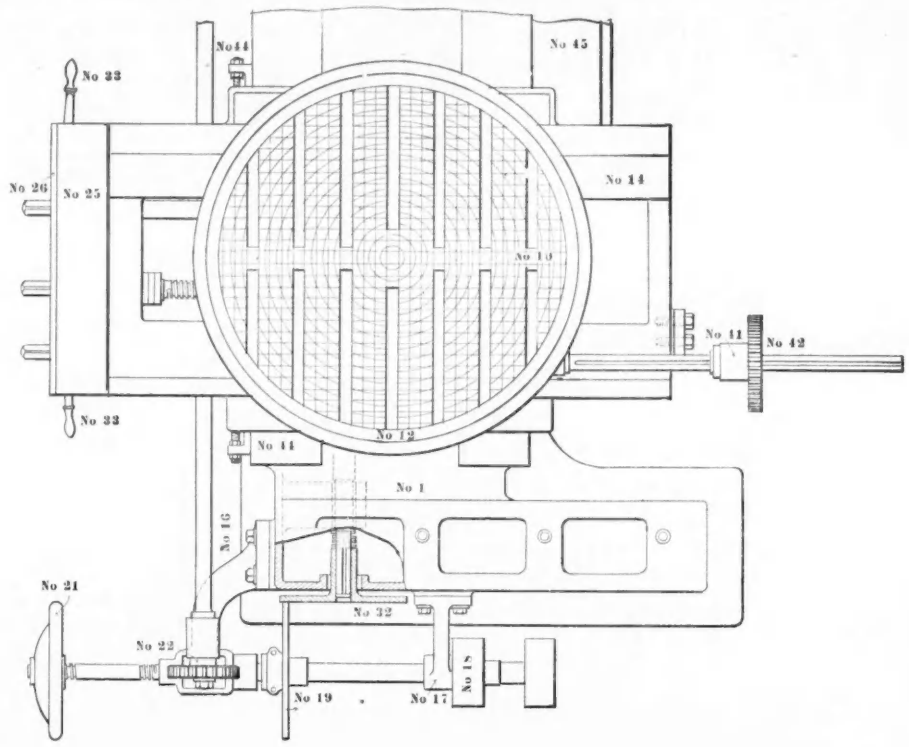
A promising sign of the times is that going to indicate continued good and increasing prices for iron and steel. The condition of the iron trade has come to be the best index in the country by which to judge of the future of pretty much every kind of business. With the iron trade good, other

things are sure to fall into line. Good crops, railroads busy and iron and steel producers crowded, and the government calling for a good deal of work, indicate plenty of work and good wages for workmen, and good business for manufacturers in the United States. And all through Europe there is more than the usual evidences of prosperity. All at work means that the products of labor are being more evenly distributed. As the world grows older it more clearly sees the benefits of universal prosperity. Nations cannot afford to be selfish.

### Lecture on Steam Boilers.

The lecture on steam boilers, by J. W. Walters, M. E., 12 Cortlandt St., N. Y., delivered 26th ult., was listened to by an appreciative audience, at the hall of the Marine Engineers' Beneficial Association, 287 Hudson street, New York. Among the audience were engineers and boiler makers of prominence.

In the preliminary remarks, the lecturer stated that it was his great love for the profession, and a sincere desire to see its members increase their knowledge by a mutual exchange of ideas and experiences, that led him to address the audience. It is by these means only that we progress and assist each other. He said, in substance: It is most fortunate that we are endowed with ambition. This prompts us to excel each other, and gives rise to constant competition, and to it we owe all advancement in civilization. The greatest material agent is steam-power, and you as engineers must feel a pride to know that this power is placed under your control. It is owing to the competition, that the science of steam engineering has advanced from the original single-acting plunger or pumping engine, to the grand structures of multiple expansion engines placed in your charge, and to manage for the welfare of humanity. The engine has of late years undergone considerable changes; in fact, I have heard it said that the steam engine is nearly perfect, but this statement I doubt. Nevertheless, the engine has been improved to a greater extent than the boiler, and it is improvements in the latter which are demanded. Advance in boiler construction can only be brought about by adopting some form of water-tube boilers. But the question arises, why should these be preferred to the cylindrical shell boiler? In the first place, water-tube boilers are far more economical steam generators; this has been proved scientifically and practically; their average economy of evaporation over the shell boiler, at 50 pounds pressure only, is said to be 20 per cent., and will be correspondingly greater for higher steam pressures. Second. Their construction eliminates the danger of explosion and the attendant calamities. Third. This adaptation of steam generation permits the carrying of high steam pressures; and furthermore, the reduced weight of material in these boilers is another item of great importance in marine engineering, where every pound of weight must be accounted for in the displacement of the vessel. The conditions required in this class of boilers for ocean service are constructive only, and there are no practical reasons why such boilers should not be used. A boiler or generator of this description, to be at all applicable, should conform to the following conditions: First, all material exposed to the hot gas, should be of wrought-iron or steel; cast-iron is not permissible, on account of its unequal expansion. Second, it must possess such design of parts, proportionate to one another, as to insure a true and positive circulation. Third, it must be accessible to the external and internal heating surfaces in order to inspect and clean it. Fourth, all generating parts should be such as to be readily duplicated at sea, even under steam pressure. Fifth, its design should be rectangular, and be conformable to the available room in the vessel without destroying the efficiency of the boiler. This may be an ideal boiler, but I am fully convinced that in time it will be produced.



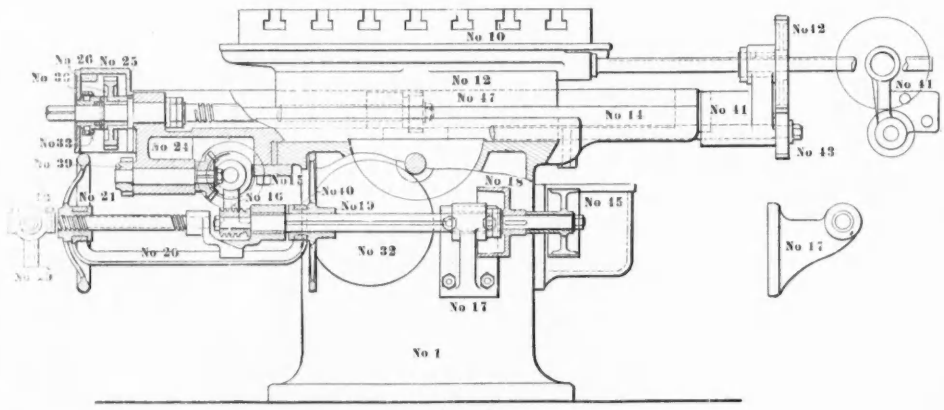




*Fig. 2.*

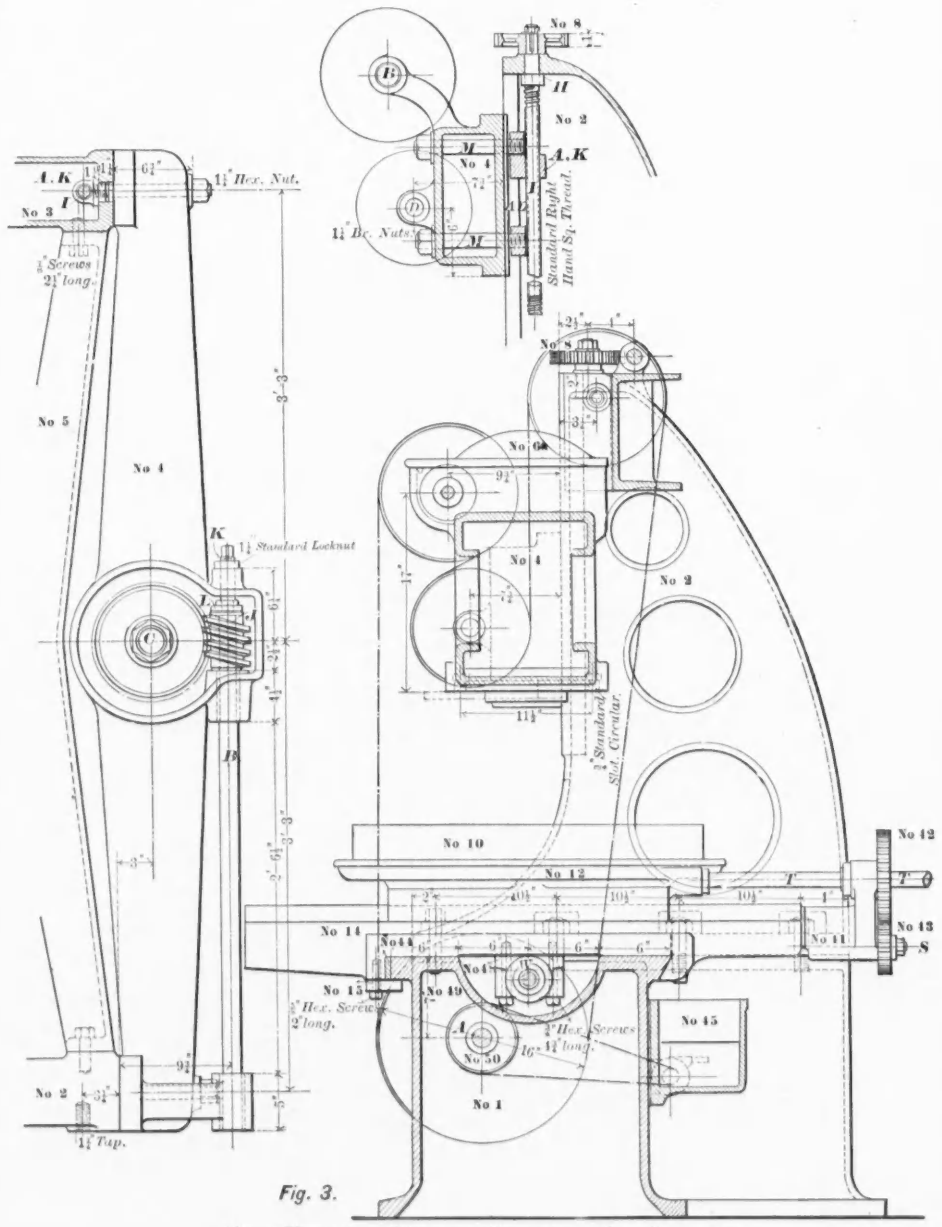



*Fig. 3.*

NEW VERTICAL MILLING MACHINE.—SEE PAGE 1.

The construction of the usual type of shell boiler, with our present mechanical facilities, demands considerations, when we wish to use steam pressure above 100 pounds. The thickness of metal demanded in this type of boiler for high steam pressure is such as to increase the difficulties of manipulation in construction, and consequently we have a limit placed in this direction. Furthermore, the element of expansion in this heavy metal is so much greater, and by the use of high steam pressure the temperature is increased to such an extent as to proportionally increase the expansion, which constantly endangers the stays and rivets, and in the rigid construction here mentioned it is a vital cause of trouble to the engineer. We must therefore construct our future high steam generators in such form as not to require stays or rivets.

So far not one of the pipe or water-tube boilers built in this country for marine use is provided with means to clean the pipes both internally and externally in a mechanical manner. Consequently the least use of salt water has been strictly guarded against to prevent incrustation. Now, it has been proven by practical experience that a moderate use of salt water, with a proper regulation for blowing off, is beneficial to a boiler of any kind, especially when new, as by its use a small deposit of scale is left upon the iron, coating the interior surfaces to an extent as to prevent corrosion by pitting. This pitting invariably takes place in marine boilers, used in connection with surface condensers, and is attributable to the action of the same water (whether fresh or salt) being used over and over again. It is therefore advisable to blow off the boiler as often as possible to renew its entire contents. The slight thickness of a pipe offers but little resistance and is quickly perforated. It is therefore necessary to have access to the interior of the pipe, to guard against pitting being carried too far before making repairs.

The next point for consideration is in connection with handling these boilers while under steam. The greatest care must be exercised to prevent a too sudden contraction of the pipes. There is nothing more injurious, than to open the fire-doors suddenly, either for firing or cooling down, especially in pipe boilers, as their light material must be humored in its contraction. A small peep-hole should therefore be placed either above or in the fire-door, for the purpose of examining the fire. Larger doors should be placed in the jacket front above the furnace doors for cooling purposes. The furnace doors should only be opened for firing, and should then be opened slowly.

With all known precautions to guard against accidents in the existing water-tube boilers, can we feel a complete assurance that no leak will develop? No, we are never perfectly at ease, but fear that the next hour may develop a leak which may necessitate the stoppage of machinery. What are the reasons for these failures? Is the material in their construction imperfect? Or is the circulation faulty? Or is the principle of generation wrong? To all these questions we must answer, No! Where, then, lies the remedy, and how can we assure a constant steam supply at all times without hindrance by leaks? The answer to this question will be found in the details of design. I mentioned before that five requirements are demanded of a perfect marine water-tube boiler. One of these is that all generating parts or elements must be such

as can be easily and quickly replaced at any time under steam pressure. We are often advised to use two boilers instead of one, in order to duplicate the power, and make the system independent in case of trouble in one boiler. It has therefore occurred to me, Why not carry this system further, and embody it in one construction in which we could have, say, thirty independent boilers or parts, each of which should practically form a boiler without interfering with the remainder in case it is disconnected from the system. And if at any time we can replace a part without entering the boiler casing, and when this part is so small as to make a difference hardly perceptible in the steam supply, we have then a construction possessing a probability of success. With these requirements in view, I designed a boiler which should conform to the demands made upon it.

The lecturer then gave illustrations of his boiler. A description of the same without the illustration would not do justice to the boiler; we therefore simply state boiler has been favorably received, and was referred to by Mr. R. Riley in his lecture on the steam engine, delivered before the same association, and noticed in our issue of November 21st ult. In explaining the action of the boiler, the lecturer said: In designing a boiler we must make provisions to facilitate the downflow of the circulating water, especially in a small pipe. We must make such downflow easy by removing it from the fire as much as possible, otherwise the heat of the pipe will drive the water upward, and the consequence is imperfect circulation and priming. It may be well to mention also another cause of priming which can be remedied in the design. As water in ebullition ascends upwards it invariably expands, thereby requiring more room. If this extra space is not given, the steam and water combined will rush along on its upward way and cause priming; but give it room to expand, the water will, by its gravity, seek a level, the steam will readily free itself without carrying any water in suspension. This is the main cause of priming in shell boilers, especially in the vertical tubular style. The horizontal boiler should never have the upper tube line above its horizontal diameter, if dry steam is required, because this surface forms the greatest area of water level, and facilitates the separation of the steam globules.

This is pre-eminently the age of steam to which the progress of our present civilization is due. It is the agency by which the imprisoned heat of past ages is made available for the use of man. We owe a great debt of gratitude to our American steam yacht owners. It is to their liberality and the deep interest they have taken in this question that we have gained much valuable experience, and obtained data for future use.

## The Best Method of Driving Dynamos.

BY W. H. BOOTH.

An electrician of repute recently remarked to the writer, that it was his opinion that dynamos should be driven either directly or by gearing, in order that any rapid or sudden increase of resistance should not be followed by a slowing down of the dynamo alone, but of the prime mover, contending that a belt-geared dynamo may slow down, and either slip its belt or throw it off the pulley entirely, whereas with a positive connection the engine feels any retardation at once, and quickly responds. This argument finds practical illustration in the many excellent examples of dynamos driven by high-speed engines. Many engineers, however, believe in engines more of the standard Corliss type driving dynamos at a much higher rate of speed than themselves, and opinion has largely veered in the direction of rope-geared engines rather than in that of belt-geared engines, which have hitherto been chiefly employed for electrical driving engines.

Several reasons have contributed towards this opinion. In the first place, ropes are noiseless, more so considerably than belts, and very much less so than even good toothed gears.

Secondly—and this reason is to a large extent rendered possible by the one just given—engine speeds can be increased considerably over those safe or usually considered safe for gears, and the stored energy in every pound weight of the fly-rim is so much increased thereby. In the third place, the great diameters and breadths of rope pulleys, as compared with gears, makes the former so much superior in weight, that, combined with their higher rate of revolution, rope pulleys are very much more effective as fly-wheels than the ordinary accepted spur gears, and render the turning of the machinery very much better and more uniform. As a fact, whilst the speed of engines has been increased so as to render a fly-wheel really less necessary than heretofore, yet the fly has been rendered still more efficient.

The result of what is rather an accident than the outcome of intentional design is concomitant with rope gears, and the ropes, which have rendered present speeds possible,

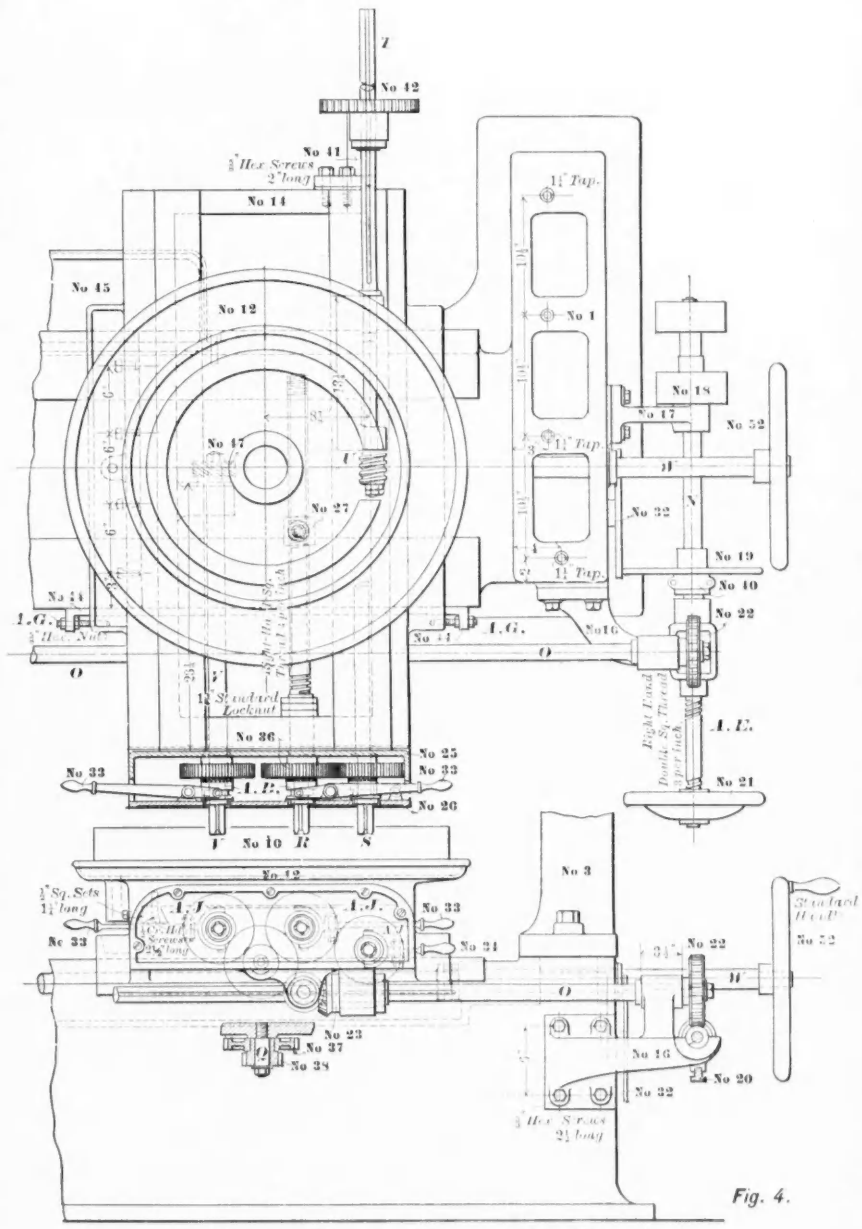



Fig. 4.

VERTICAL MILLING MACHINE.—SEE PAGE 1.

and present weights necessary as being contingent on diameter and breadth of fly-rim, have received the credit of all the improved turning, simply as ropes, without an intelligent interpretation of conditions.

In respect to the driving of dynamos, ropes have an advantage over belts. The latter are well known to be frequently thrown off the dynamo pulley when the resistance of the machine has been suddenly increased by an increase of load Now if it is preferable in such an event that the driving engine should be brought up, rather than that the belt should be unshipped, then ropes offer a means of securing this. Owing to the form of the grooves in which they run, they cannot be thrown off by an increased resistance, but rather bury themselves more deeply in the V shaped grooves, and so obtain an increased resistance against slipping, impossible with belts. In this way they are better able to effect the slowing down of the prime mover under circumstances requiring this, whilst they obviate the attendant inconveniences of slipping belts, and the danger of racing which may accompany an unshipped belt.

Here, as a diversion, it may not be out of place to remark that large engines which will run at speed at pressures of, so to speak, a pound or two effective, may be found to run with such a vacuum as would accompany even the earliest cut-off of a Corliss valve, and where there is a chance of all power being suddenly thrown off, a certain excess of speed of governor rotation should be made to open a direct connection from the atmosphere to the condenser, so as to vitiate the vacuum and prevent danger of racing.

In England, where the highest class of engines for motive power are those of the cotton mills, which almost universally employ rope gears, the principle is extending to dynamo driving, and engines of 2,500 horse-power are in hand for driving large dynamos. For such a power the number of ropes employed will be 40 of 1⅜" diameter.

For heavier work than this, as for dynamos of 40 feet diameter, the dynamo is placed directly upon the engine shaft, so forming itself the fly-wheel. Such an arrangement is necessarily only suited to particular installations, and the vast majority of dynamos must be driven through some form of gear, and for this purpose ropes present very many points of superiority over belts. In justice to belts, however, it must not be forgotten that so far they have always shown themselves more economical than ropes. Probably such would not be the case where the ropes rest upon the bottom of semi-circular grooves, for then each rope is running upon a pulley of fixed diameter, and there can be no friction due to differential slip between one rope and another, such as must occur when many ropes of slightly different diameters are held in V grooves. The round-bottomed groove, however, has not the power of preventing slip under an increased resistance which is possessed by the V groove, and is therefore little used, though it is claimed as the only suitable groove for use with ropes of wire, which will not, it is said, even when cased in washers of leather, have the compression put on their strands when run in V grooves.

Where ropes of cotton or hemp are not desirable the rectangular rope of leather running in a right-angle groove possesses many of the advantages of the ordinary rope, for a tendency to slip under increased resistance is counterbalanced by the wedging action of the groove. Leather also has, per unit of weight, a greater tenacity than ordinary rope, and can therefore with economy run at a high velocity owing to the fact that the limit of speed is higher on account of the diminished centrifugal force stress, which, at a few thousand feet per minute, takes away from the working efficiency of a belt or rope more than the speed adds thereto. For cotton ropes a velocity of 5,000 feet per minute is about a maximum, for hemp probably 6,000 would be admissible, whilst for leather it is probable that 7,000 feet might be attained without exceeding the limit at which an increase of speed ceases to add efficiency.

The writer has no information as to the driving of dynamos by frictional gearing, but is inclined to the opinion that it would hardly be suitable. All engines run best, especially if of large size, when they have a slight play in the crank-shaft bearings. With toothed gearing this is easily effected, both radially and parallel with the shaft, but with frictional gears it would be difficult, and every blow of the piston and other parts would serve to jar the dynamo far more severely than even toothed gears, which also seem unsuitable for dynamo work. Weighing the pros and cons of each system carefully, it seems as though ropes would best fulfill the requirements of electrical service with general all-round satisfaction and efficiency, so long as they are of such nature and form as will bear to run without injury in wedge-shaped grooves. In designing such grooves an angle of 45° is common. Duree in 1876 recommended an angle of 40 degrees. In good workshop practice several grooves are turned up together, the tool-slide carrying half a dozen tools and a more exact uniformity of groove being secured.

Forty ropes are, we believe, the largest number yet provided for on a single driving pulley. I know of two rope drums of 40 grooves. In one case—a cotton mill—the 40 ropes are led off to several pulleys. In the other case they drive only a single dynamo.

After all, electricity is only a form of energy, and for its economical production and expenditure, requires the same care and precaution as other forms of power or work. Hence a uniform speed and fly-wheel of large store of energy, with sensitive regulating apparatus, are necessary to success. Where belts are preferred it is well worth considering whether, in place of using them of 36 or 48 inches in width, they should not be at a maximum no more than 12 inches. The crowning of pulleys necessary for belts is productive of considerable loss, especially as the ratio of crowning to diameter is less on the large driver than on the small driven pulley. The discrepancy is far less for narrow belts, and the latter also are more suited for high speeds than belts of great width which carry with them so much air, and are thereby caused to surge violently. Leather, however, is stronger than ropes of fiber, and hence may be made into ropes and run economically at a higher velocity, and therefore exert greater horse-power per inch of pulley face.

Taking all circumstances into consideration, it appears as though dynamos may be best and most economically driven by ropes of cotton, hemp, leather or metal.

Many of the buildings destroyed by the recent fire in Boston were believed to be fire-proof. Circumstances seem to prove that there is no such thing as a fire-proof building, and probably in the instance of narrow streets there is not, as yet.

It is said that if ten American novelists whose books sell readily are selected, and ten mechanics who earn $2.50 per day, at the end of ten years the mechanics will have earned the most money.

## Force, Motion and Work.

BY PEDRO.

SEVENTH PAPER—COMPOSITION AND RESOLUTION OF MOTION.

In Fig. 15 we represent a device by means of which a point $A$ can be moved in two directions at right angles to each other with the screws $B$ and $C$. The slide-bed $G$ is attached to and slides upon the fixed bed-piece $F$, the former being moved by means of the screw B. In a similar manner a slide $H$ is operated with the screw $C$, which, with the slide $H$, is attached to the slide-bed $G$. Suppose a pin $A$ fastened to the slide $H$. Now let us suppose the screw $B$ to be turned in the direction of the arrow with a uniform speed, so that the point $A$ will be moved from $A$ to $D$, a distance of four feet, in one minute. At the end of one minute, when the point $A$ is at $D$, let the screw $B$ be stopped, and screw $C$ started so that the point $A$ will move from $D$ to $I$ in one minute, a distance of three feet. By turning screw $C$ the first minute, and $B$ the second, the point $A$ will arrive at the same point $I$, in two minutes, but by way of the point $E$ instead of $D$.

Now, if we turn both screws at the same time, with the same speed and in the same direction as before, it is evident that each screw will move the slide $H$ the same distance as before, and consequently the point $A$ will arrive at $I$ in one minute in this case; but instead of moving along the path $A\ D$, $D\ I$, or $A\ E$, $E\ I$, it moves along the diagonal $A\ I$, of the parallelogram $A\ E\ I\ D$, and since we have assumed the distances moved in one minute, these will be the velocities, viz., $A\ D = E\ I = 4'$, is the velocity of the point $A$, imparted to it by the screw $B$, and $A\ E = D\ I = 3'$ is the velocity in the direction of the screw $C$. In this case the length of the diagonal $A\ I$ is five feet, hence, when the two screws turn at the same time, the resulting velocity of the point $A$ is five feet, and the diagonal $A\ I$ is the direction in which it moves. This parallelogram is called the *parallelogram of motion*. The two primary motions, represented by the sides of the parallelogram ($A\ D$ and $A\ E$) are called the *components*, and the resulting motion, or the diagonal $A\ I$, is called the *resultant*.

The principle illustrated above is true without regard to the angle that the screws may make with each other, or to the direction in which they may be turned, except that the resultant will lie in the angle between $C$ and $D$, if the screw $C$ is turned in the direction opposite to the arrow. If $C$ is turned with the arrow, and $B$ opposite to it, the resultant will lie in the angle between $B$ and $E$. If both screws are turned opposite to the arrows, the resultant will lie between $B$ and $C$, as indicated by the dotted lines. Hence, the device shown in Fig. 15 enables us to move the point $A$ in any direction of the four points of the compass.

It follows from the above, that if a body is moving from two causes, and we know the direction and velocity of the body due to each cause, we can find the resulting velocity and the direction in which the body will actually move, as in Fig. 16, where $A$ represents the starting point, $A\ B$ the velocity due to one cause, or simply one component, and $A\ C$ the other component. To find the resultant we simply "complete the parallelogram" by drawing a line from $B$ parallel to $A\ C$, and one from C parallel to $A\ B$, then from the starting point $A$, we draw the diagonal to the opposite angle, $D$, which will be the direction of the resulting motion, and its length will be the resulting velocity, or simply $A\ D$ will be the resultant.

When there are more than two components, as $A\ B$, $A\ C$, $A\ D$, in Fig. 17, we can find the resultant of these by taking two of them, as $A\ B$ and $A\ C$, and finding their resultant, which is $A\ E$. Now find the resultant of $A\ E$ and the remaining component $A\ D$, which is $A\ F$. $A\ F$, then, is the resultant of the components $A\ B$, $A\ C$ and $A\ D$, that is, the one motion $A\ F$ takes the body to the same point that the three components $A\ B$, $A\ C$ and $A\ D$ would take it. By the same process the resultant of any number of components may be found. This process is called *the composition of motion*, because the several components or motions are composed or brought together into one which has the same effect.

*Resolution of motion* is a process opposite to the above; that is, a given motion may be resolved, divided or separated into two or more components, whose effect will be the same as that of the original motion.

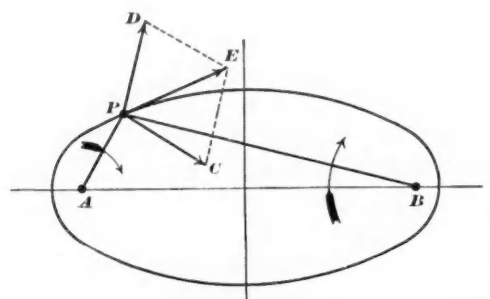



Fig. 21.

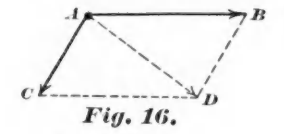



Fig. 16.

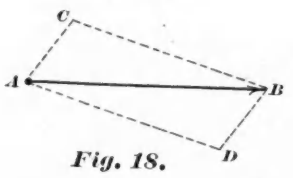



Fig. 18.

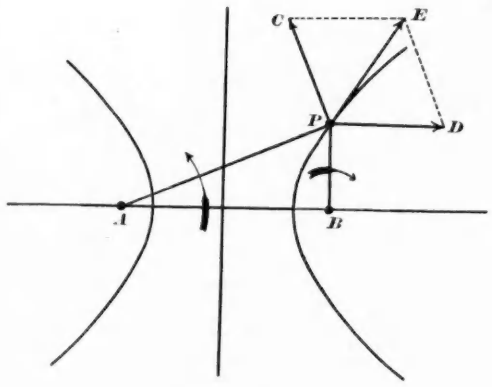



Fig. 23.

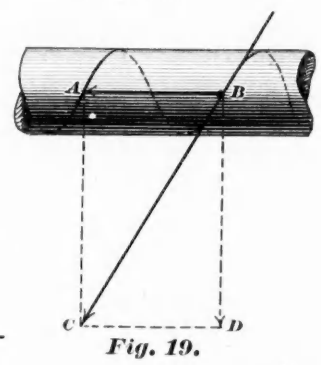



Fig. 19.

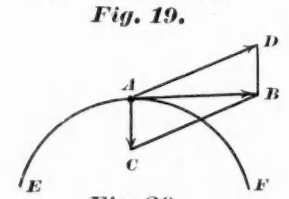



Fig. 20.

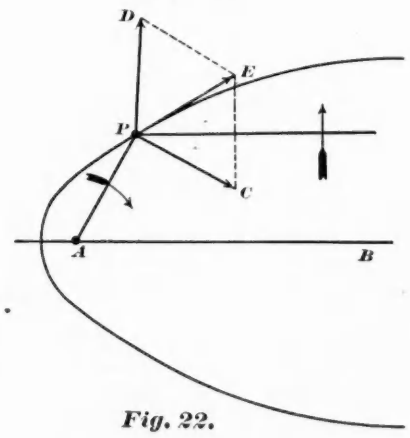



Fig. 22.

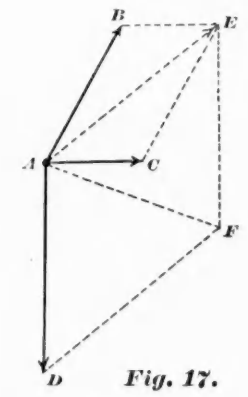



Fig. 17.

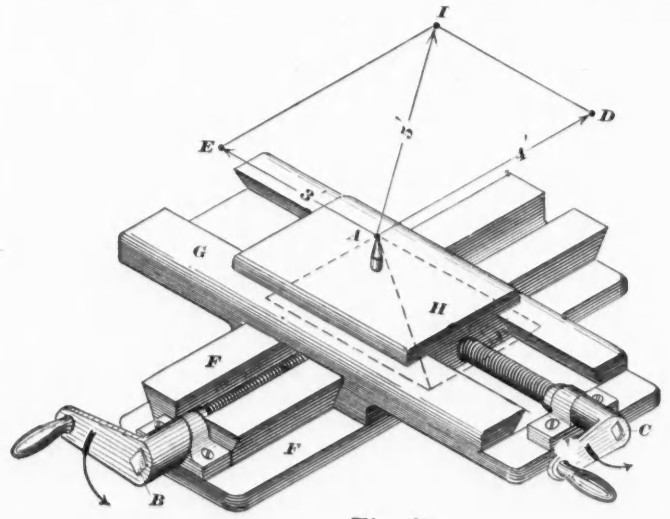



Fig. 15.

FORCE, MOTION AND WORK.

In Fig. 18, let $A\ B$ be the velocity of any moving body. If we take this as the diagonal of a parallelogram, then the sides, as $A\ C$ and $A\ D$, will be the components. It is evident that an infinite number of parallelograms can be drawn, of which $A\ B$ will be the diagonal as long as neither one of the sides is limited; but when the motion $A\ B$ is given, and also one of the components into which it is to be resolved, as $A\ C$, then there is but one solution of the problem. The original motion $A\ B$, and the given component $A\ C$ being drawn, both in direction and magnitude, there remains nothing more to do but to join $C$, the end of $A\ C$, with $B$, and draw $A\ D$ parallel to $C\ B$, and $B\ D$ parallel to $A\ C$. $A\ D$ will be the other component.

In dealing with these problems, it is not necessary that we take the velocities in constructing the parallelograms. The distances moved in any given time may be taken as well. For example, in milling spirals on the milling machine, we have a practical application of the resolution of motion. In this case the distances passed over during the time of one revolution of the work, is more convenient than the actual velocities. In Fig. 19 suppose it is required to mill a spiral of a certain angle represented by the line $B\ C$, that is, $A\ B\ C$ is the angle of the spiral. The line $B\ C$ is the direction that the tool or cutter must move to produce the spiral, and $B\ C$ is therefore the resultant. The component, which is known in this case, is $B\ D$, laid off at right angles to the axis of the work because this is the direction in which the point $B$ moves in its revolution about the axis of the work. $B\ D$ is laid off equal to the circumference of the work, because that is the distance the point $B$ moves in one revolution. Draw $D\ C$ parallel to the axis of the work, because this is the direction in which the work feeds; complete the parallelogram. Then will $A\ B$ be the other component of which $B\ C$ is the resultant. That is, $A\ B$ is the distance the work feeds during one revolution of the same. We know now that the machine must be geared up so that the feed-screw will move the work a distance equal to $A\ B$ while the spindle of the spiral head makes one revolution.

The same problem and remarks apply to screw cutting on the lathe, since a screw-thread is nothing but a spiral. Since $A\ B$ is the feed of one revolution, it is the pitch of the spiral or screw.

When a body moves under the influence of two component motions, and one or both of them are variable, then the path of the body will always be a curved line, and the line which represents the resultant motion at any point of the path will always be tangent to the curve. For example, if the curve $E\ A\ F$, Fig. 20, is the path of a body which has the component motions $A\ C$ and $A\ D$ when it arrives at the point $A$, then the resultant, $A\ B$, will be a tangent to the curve at the point $A$. This fact has already been stated in connection with circular motion, Fig. 4, third paper.

According to this general principle the conic sections may be regarded as generated by a point rotating at the same time about two fixed points as centers, those points being the foci of the curve, and both rotary motions being such that the circular velocities at any given point are the same; also, both rotary motions being in the same direction in the ellipse and parabola, but in opposite directions in the hyperbola as indicated in Figs. 21, 22, and 23. In each diagram $P$ represents the moving point which rotates with a circular velocity, $P\ C$, about the center or focus $A$, and a circular velocity $P\ D = P\ C$ about the other focus $B$. In the parabola, Fig. 22, the focus $B$ is at an infinite distance from $A$, hence the circular motion about that focus is in a direction at right angles to the axis $A\ B$. The resultant, $P\ E$, of these two motions, $P\ C$ and $P\ D$, being the actual direction in which the point $P$ moves, is tangent to the curve at the point $P$. The circular velocities $P\ C$ and $P\ D$ being equal to each other, the rotary velocities about the foci are in the inverse ratio of the distance of the point $P$ from those foci, thus (by rule 10, third paper,)

$$\frac{\text{Rotary velocity about } A}{\text{Rotary velocity about } B} = \frac{B\ P}{A\ P}$$

## Economy in Boiler Firing.

Economy in the use of fuel in steam generation is again so important an industrial matter that no one can afford to be indifferent to the attention now being bestowed upon it. A recently published paper by Mr. W. J. Bird gives an elaborate and careful statement of a long series of experiments in the firing of boilers which have been carried on at the Wingate Grange Colliery, Durham. The object of these trials was to establish the relative value of mechanical stoking and of hand-firing; and one of the results quoted is an annual saving per boiler per annum, where small coal is used, with the mechanical stoker, of £82 14s. 9d. If, however, the hand-firing with small coal is compared with the mechanical firing with "duff" coal, the saving is much greater, amounting to £170 10s. 1d. per annum. The increase of duty obtained from a boiler by the use of the mechanical stokers is 33.3 per cent., of which 20 per cent. is due to the movable bars. These figures are chiefly valuable as presenting a clear statement of the practical value of mechanical stoking, but the reading of the paper last week at the South Staffordshire Iron and Steel Works Managers' Institute provoked some interesting remarks upon the general question of boiler economy. One suggestion made in the course of the discussion upon the paper

was that the fuel should be burnt in a simple combustion chamber placed in front of the boiler, and serving the purpose of a regenerative furnace. The adoption of this expedient, which is a matter of only a few pounds' outlay, has resulted in enabling a steam user to do with three boilers the work that has formerly taken four. One fact recorded in Mr. Bird's paper furnishes a striking example of the frequent conflict which arises between the results of practical work and the opinions of scientific authorities. Mr. Bird found, in actual experiment, that the falling off in a boiler's duty as the result of a scale of $\frac{1}{16}$in. is only 1.5 per cent.; whilst engineering text-books and teachers give the loss of efficiency from such a thickness of scale as something relatively enormous. Another member, however, corroborated Mr. Bird's result, also quoting from practical experience. He very rightly added that the effect of dirty water upon a boiler very greatly depends upon the character of the dirt, and that a gritty deposit will be comparatively harmless, while one of a greasy character will very materially interfere with evaporation. It must be remembered that, though the loss from $\frac{1}{16}$in. scale is only $1\frac{1}{2}$ per cent., yet the injurious effect of scale increases in much greater ratio than its thickness —*The Engineer* (London).

## A New Form of Bevel Gear Tooth.

BY GEORGE B. GRANT.

This form of bevel gear pin-tooth appears to be novel; at least it is not described in any of the well-known treatises on mechanism.

The bevel wheel *A* is furnished with conical pins *B*, which work with conjugate tooth surfaces formed on the mating gear *C*, precisely as the common spur pin-tooth works with its gear. The apex of the cone of the pin *B* is at the common center or intersection of the axes *D*, and its axis *D E* lies in the pitch cone of its gear.

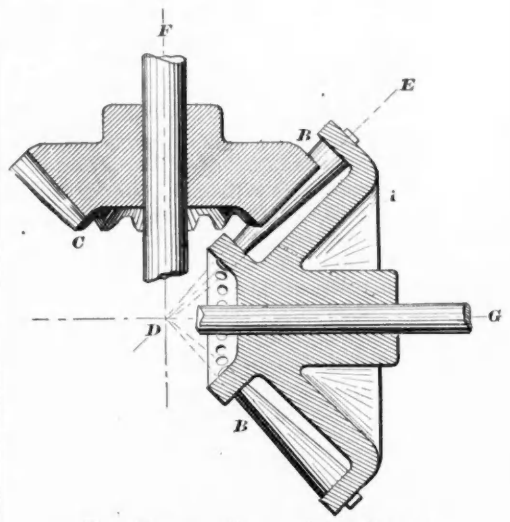
This form of tooth, like the common spur pin-tooth, is subject to the troublesome cusp and consequent interference, and it can be avoided only by setting the axis of the pin inside of its pitch cone.

It would be a simple matter to construct a machine to trim the surfaces of the teeth of the gear. The cutting tool would be a revolving milling cutter of the form of and in the position of the pin. The two shafts would be geared together in the proper proportion, and as they revolved, the cutter would shape the tooth surface. The machine would apply as well to the spur pin-gear, if the two shafts *D F* and *D G* were parallel.

The kind of water that is frequently furnished for domestic purposes was very well illustrated by a recent occurrence in a city not far from New York. During the recent heavy rains the cellars in some parts of the city were flooded, and the authorities were sure a water main had burst. But the inhabitants successfully demonstrated the contrary by showing that the water in their cellars was clearer—or rather less muddy—than that coming from the service pipes.

## A New Link Valve Motion Model.

No better evidence of the fact that the practical men who are doing the work on the railroads of the country are taking an increased interest in matters pertaining to their business could be desired, than is furnished by the correspondence of this office; large numbers of letters being received from such men inquiring either directly for information, or for the means of informing themselves regarding the underlying principles which nearly all recognize should be understood by him who aspires to be a practical man in the true sense of the term.

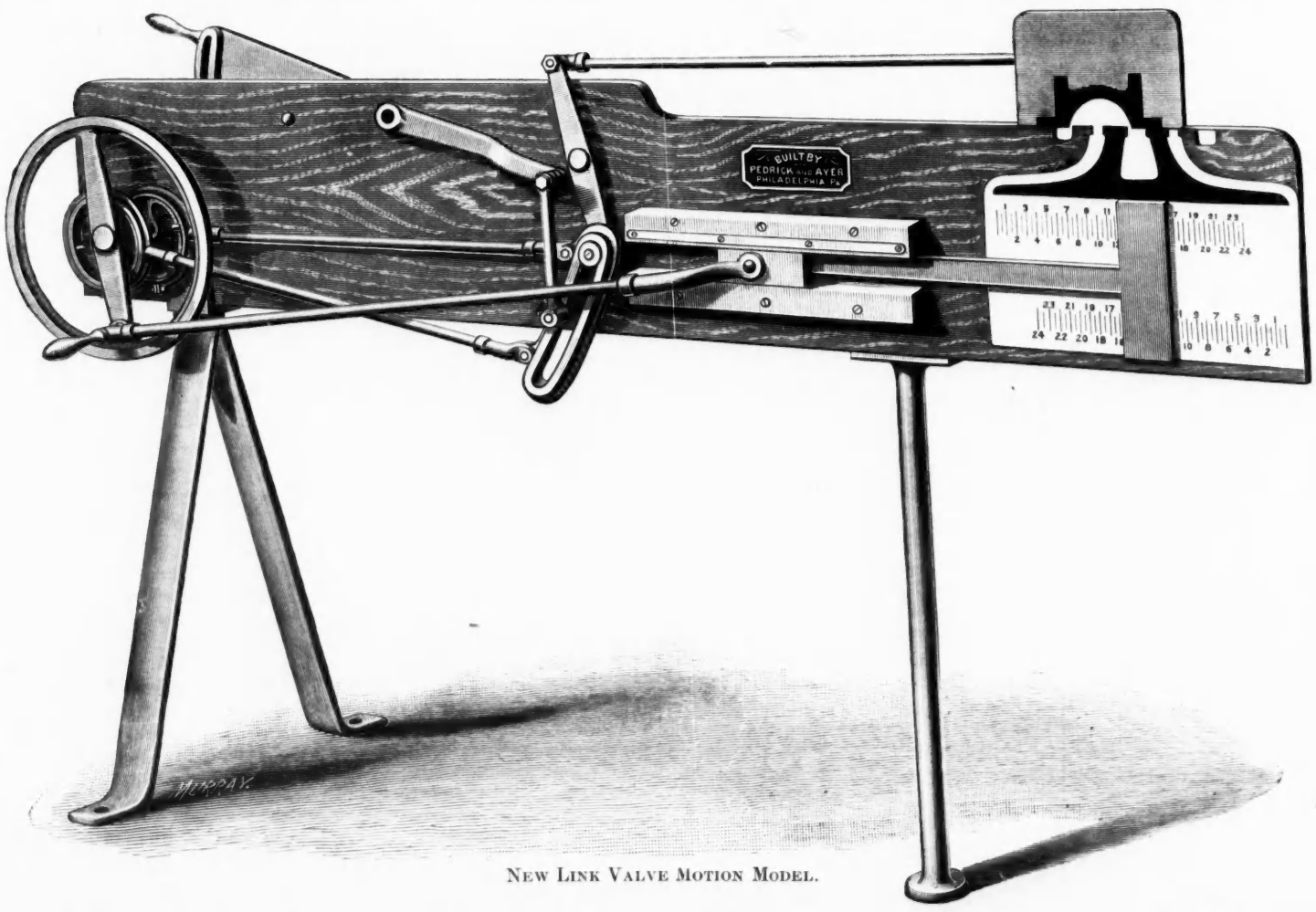



NEW FORM OF BEVEL GEAR TOOTH.

This correspondence has shown unmistakably that there is a demand among locomotive enginemen for a valve motion model adapted specially to their use, and by means of which the principles of the link valve motion, and the distribution of steam in the locomotive can be systematically studied, and what is equivalent to practical experience in setting valves and eccentrics gained. This demand has led to the designing of the link valve motion model, which we illustrate on this page, and in which special pains have been taken to adapt every feature to the special needs of enginemen who desire to become familiar with such motions as are found upon American engines, so that, when problems arise upon the road or in the roundhouse, little or no trouble will be experienced in their practical solution.

All the principal dimensions and motions of the model are made just one-half those of a standard eight-wheeled 17″x24″ locomotive, and all the parts which can be adjusted on such a locomotive in setting valves can be adjusted on the model; so that the operation of setting valves is in all essential points precisely the same upon each; the different parts of the model being placed in their true positions relative to each other, as found upon the actual locomotive. In order to set the valves on the model, precisely the same operations must be gone through with as are required in actual practice. The true dead centers must be determined in the same manner, after which the length of the eccentric blades and the position of the eccentrics must be adjusted until the valve is seen to be right, trams being furnished with the model for use in this operation.

The frame of the model is of wood, with the bearing for the rock-shaft bushed with brass. The bearing for the main shaft or axle is a long cast sleeve attached to the back by means of a wide flange. A square shoulder is formed on the face of the wheel, to correspond to the inner surface of the tire where it projects over the wheel center, this shoulder affording facilities for drawing arcs of circles and tramming to determine the true dead centers. Only two arms are made in the wheel, so that the movement of the eccentrics may be more readily seen, and to make them convenient for access in setting. The eccentrics are fastened by set-screws, having copper disks under them to protect the axle from being bruised. The eccentric blades, connecting rod and valve stem are of polished brass tubing, threaded at the ends, and provided with knurled collars for locking them in position. The eccentric blades have right-hand threads at one end, and left-hand at the other, so that by loosening the knurled collars and turning the tubes, the length of the blades is adjusted. The plank, which forms the frame, is painted black, and the unfinished parts of the motion a lighter color, in order to form a contrast and make them plainly visible throughout an ordinary room or hall, and at the forward end a section of a cylinder, ports, valve seat and valve are represented, and two scales are provided—one reading to the right and the other to the left—over which the piston travels. These scales are divided and numbered to represent half inches of stroke. As the piston passes over them they indicate directly just what part of the stroke has been completed, and what part remains to be passed over, in either direction, and without the necessity for making subtractions. Though the common and generally approved practice is followed in proportioning the ports and valve, it is obvious that, for experimental or other purposes, any desired proportions of either may be laid off on paper and attached in position by thumb tacks, covering the ports and valve already laid off. In this way, valves with more or less inside or outside lap, or ports of different proportions, may be experimented with, and their effects on steam distribution —admission, cut-off, compression and exhaust—readily observed.




NEW LINK VALVE MOTION MODEL.

The travel of the valve is $2\frac{1}{2}$ inches, representing 5 inches travel on the engine, and the scales are so numbered as to read as the full-sized engine would; so that when any action of the valve takes place, the scales show directly the corresponding position of the piston in the engine, the same as though the model was full-size. The reverse lever and notched quadrant are replaced by the piece seen projecting above the frame at the back, which may be adjusted for any desired point of cut-off, and clamped by a thumb-nut. The point of cut-off is determined by moving the piston to the desired point in the stroke by the scale, and then adjusting the reverse lever until the valve is seen to be in position to cut off. This construction is thought to be much preferable to having a notched quadrant for this purpose, because it can readily be set to cut off at any desired point, regardless of lost motion, and is equally well adapted for valves having different proportions. The reverse lever is made of such form and proportions as to counterbalance the link and its connections, and, in fact, the entire model is balanced so that it will stand in any position. The wheel can be turned from either side, there being a crank at the back, which does not show in the engraving.

On the back side of the valve-block is a device which, when thrown into action, makes a distinct snap as the valve moves in either direction. The device may be so adjusted that this snap takes place at the moment of exhaust, so that, when studying the motion, any part of it, such as the piston or crank-pin, can be watched, and its position at the time of exhaust observed, which would not be possible if both points had to be watched for. This is effected by means of two swinging tappets, which travel with the valve, and which alternately engage and re-

lease small springs, which, as they strike upon seats provided, make the desired noise, or snap. The swinging tappets can be turned up out of the reach of the springs when the device is not needed, and the springs are adjustable so that it may be made to suit valves having more or less inside lap, or may be made to announce admission or cut-off instead of exhaust, if desired.

This feature, together with the fact that all the working parts are at one side, where they are plainly visible, makes the model well adapted for use in lectures, or for explaining before an audience its action, or for use by lodges or other associations of enginemen. By means of it, any one who desires may set and re-set valves, studying the principles involved as he goes along, and at his leisure, until he becomes satisfied that he thoroughly comprehends the principles involved. It was designed by Messrs. John A Hill, editor of *The Locomotive Engineer*, and Fred J. Miller, of this paper, and is manufactured by Pedrick & Ayer, Philadelphia, Pa.

## LETTERS FROM PRACTICAL MEN.

### Counterbalancing Engines.

*Editor American Machinist:*

Apropos to the discussion on balancing engines, why is not an engine having two cylinders whose axes are in the same plane, and at right angles with each other, capable of a perfect counterbalancing?

We will suppose the engine to be connected not with connecting rods, but with cross slots and sliding boxes on the pistons. Let the counterbalance be opposite the crank, and exactly equivalent to *one* piston and its appurtenances. To make it just right it should be divided and put one half on each side of a double crank, as shown in one of the illustrations of last week.

The work of the counterbalance will then be alternated between the two pistons, in accordance with their accelerations and retardations, so as to exactly compensate them both.

If connecting rods be used, the compensation will not be so exact, owing to the inequality introduced into the piston motion, and to the small part of the connecting rod that cannot be perfectly balanced.

I do not know whether this plan is new or old, but if the idea is valid, why has not more use been made of it in designing small high-speed engines? Working two cylinders quartering on the same crank is common enough, but I have never seen it noticed that a perfectly balanced engine could be made that way. JOSEPH P. NOYES.

### Lathe Centers.

*Editor American Machinist:*

All great reforms, whether of a social or political character, are brought about by agitation, and the way to reform the evils, which Jarno finds in lathe centers, is by the same great power that, when once started, never rests until its object is accomplished. The writer recognizes the full force of the evil from practical experience, and would act on the suggestions advanced—to bore out the spindles; but it would be only a temporary expedient so long as lathe makers adhere to the same old system—or rather lack of system—in multiplying tapers. The reform, to be effective, must be applied where the lathe spindles are made, and any remedy proposed, to be effective, must be acquiesced in by the lathe makers. To accomplish that end, I would suggest a meeting of one representative of each firm who are engaged in the manufacture of lathes, with power to adopt a standard taper for lathe centers. Having such a taper, the lathes now in use could be changed to correspond to it, with some assurance that the process would not have to be repeated every few years. The expense of such a meeting would be a very small item compared to the good that would result from its successful issue.

I would suggest two ways to bring about such a meeting: First; let two or three well-known firms join in issuing an invitation; or, second, the invitation to come from the AMERICAN MACHINIST—a recognized authority in mechanical matters—appointing a time and place of meeting. To such an invitation I think all firms would respond, thereby taking the first step that would lead to a reform so devoutly to be wished by TOOL ROOM.

## Extracts from an Address to the Apprentices' Association of the Brown & Sharpe Mfg. Co.

BY GEORGE H. SMITH.

Recently Mr. George H. Smith delivered a very instructive address before the above-named association, from which, through the courtesy of the lecturer, we are permitted to extract as below. The speaker said:

When I received your invitation to address you, I decided to give you a few of the impressions I had received during my apprenticeship, and as journeyman machinist and draftsman. The machinist trade consists in manipulation of tools and machines to produce the different parts of a machine. It is mechanical, pure and simple. A young man has one of two reasons for going into a machine shop, either as an occupation for the time being, or as a business to follow through life.

One man may produce better or more work than another, which in itself proves we must look to the man and not the machine for the reason. Mechanics, I believe, are born, and not made. We sometimes hear of boys who have no natural ability, who are put at the trade, and, through good teaching, become mechanics. I think this a wrong statement of the case; he had the ability naturally, and the teaching brought it out, only. The fact is, to be a mechanic one must have natural mechanical ability; please note, I say mechanic, not machinist.

A machinist "is a constructor of machines," while the science of mechanics treats of the laws of motion and force; thus the distinction.

First, I would advise an apprentice to be observing at all times; let nothing escape you, and if you cannot satisfy yourself that you understand what you see, ask questions. If the one you ask says he has no time to explain, then ask some one who knows. This no time excuse is only a common way—and much too common—of saying, "I don't know"; keep at it; learn the reason why. You will find some one who knows more about it than you do yourself, and that's the man you want to find. Do not stop looking for facts because some one sneers at your persistence; keep at it; you will soon be beyond his sphere; and remember, the harder you are obliged to work for the information, the longer you will retain it. There is a reason for everything, though we may not readily perceive it.

Educate yourself in all ways possible. How often we hear some one wish, or even we ourselves wish we had the education A, B or C has. By education, I mean the usual acceptation of the word—which is book learning. That is a great help we can conceive, but let us see if we are in such a very deplorable condition without it, after all. We know of men who have had but the simplest schooling from books, and they have met with success. We know of men with the most expensive and painstaking book learning which can be acquired, and yet they are failures. We know of men well educated in every way, and they in turn met with grand success. We know of men who have had but poor schooling, and they in turn acquire nothing, and are of poor service to any one. Now, you see, we have four illustrations—two with poor schooling, one meets with success, one does not; two with good book learning, success meets the one, and passes the other. Then what is it that succeeds? It is good, common sense—sometimes called "horse sense"; you cannot buy it, you cannot beg it. If you have it you are rich; without it, you are poor indeed. It is the application one makes of what one has, be it learning or be it something tangible. There are many rich men to-day who would be glad to strip from their boys all the advantages he ever gave him, could he invest him with good common sense. You may ask, "Is it possible to acquire common sense if one is not fortunate enough to be born with it? I should say while it might be possible, it is not probable that such a person would have sense enough to try to acquire it. However, we must be generous enough to allow that all of us have some common sense; it is simply a matter of quantity or quality. So I believe one can acquire or add to his store of common sense, the same as he can to his good manners. However richly endowed you may be with it, cultivate all you have; it's a prize beyond price.

There are some things we meet with in the shop which we ought to avoid. One is the association of grumblers or "croakers," "chronic growlers"—you have all seen him (and you always will). There is no place too large for him; there is no place too small for him. The chronic grumblers have a particular animosity against the shop they are working in—strange they don't go elsewhere—and sometimes these grumblers are the men who have been in the shop the longest, and are old enough to know better. Nothing is as they would have it—the hours are longer, they don't begin or end as they should, and the rules are all iron-clad, etc., etc. The pay is smaller than in other shops, and so it goes; one time there is no boss, then there are too many bosses; one of their favorite quotations is, "No man can serve two masters" (and they might add, some men are of poor service to one). This is all wrong, and is due to the disposition of the man, and not to his surroundings. By the disposition of the man, I do not mean that it is necessarily the natural disposition; the croaking, grumbling disposition can be acquired very readily. We know it is not the circumstances surrounding the man, because we find others in like surroundings, in every respect, and they are not grumblers. There is no lack of opportunity for something to grumble at; do not encourage the disposition. We know it is only our criminals who complain of our penal institutions; an honest man has no use for them; he never complains of these to his neighbor. And so it is with your shop mates. He who is honest and loyal to his employer and himself has no such complaints. These stringent iron-clad laws—prison workshops we hear so much of—can be taken care of by the croaker; we have not noted these fearful conditions, and don't care to.

One other practice prevalent in the machine shop is playing pranks, sometimes called "practical jokes." Why they were ever called practical is beyond my comprehension. Webster says: "A practical thing is capable of being turned to use"; so they cannot be called practical.

I trust you will look kindly upon these few hints, as I could not think of speaking to you without noticing these facts, which to me, when I began the machinist trade, at the age of 15, I encountered and had to fight against, and so I feel a word of caution may do some one a service.

There is no part of the machinist trade so important or so necessary as drawing. I think it would be almost a waste of time to enlarge upon its advantages. You must all comprehend my full meaning. How is the best way of learning mechanical drawing? This I cannot answer, though I can tell you of a good way. First, it is very necessary to make up your mind you are going to learn it. No ifs or ands must stand in the way. If your mind is imbued with this idea, no power of man can keep you from acquiring the art.

To begin, you need only a pencil and a small blank book; let your first efforts be to sketch, not pictures—don't I beg you, allow yourself to connect the word picture with a drawing of machinery—(though Webster says "any kind of a drawing is a picture.") I always associate a picture with something made only to please the eye. I have seen many drawings which were invaluable as records, but were far from pleasing to the eye from an artistic standpoint.

Here the speaker sketched a few simple objects which he said required but two views to show all their dimensions. He continued:

In sketching, you not only learn to observe all there is about a piece that is important for reference, but the mind becomes so accustomed to a correct conception of what you see, that it is without effort you are enabled to read drawings placed before you; I know of men who can make with tools a good drawing, but cannot sketch, and they have been sorely embarrassed when trying to convey an idea, not being able to sketch it.

Mr. Smith then took up more complicated parts, requiring several views, sections, etc., and proceeded to give a most admirable lesson in sketching. Coming to working drawings he said:

We will now assume you have practiced sketching details, so as to enable yourself to get all the necessary figures to make a working drawing, bearing in mind what you do is for profit.

Now if you had absolutely nothing to draw with, I would say procure a drawing board about 20″x24″, one end true or straight, a tee square with 24″ blade (swivel head always), a pair of try squares 5″ to 8″, one 45° and one 30 and 60°, a pair of 6″ compasses, a lead pencil quite hard, also a soft one for sketching, that is all—*actually all*—you require to become a good draftsman; of course there are many more tools which are handy, and you will some time need them should you make drawing your business; but every apprentice could get what I have named, and all might not be able to get a full set at once.

This was followed by excellent instruction, covering many points in mechanical drawing, freely illustrated with sketches.

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In a paper on chimneys, read before the American Society of Mechanical Engineers by Horace B. Gale, the author gave expression to the following, in which he will be sustained by every observing steam engineer of experience in the country.

"Again, from the same theory of draught is deduced a law, so called, which asserts that, no matter what the dimensions of the chimney and furnace, the maximum draught will be attained when the temperature of the chimney gases is such that their density is just one-half the density of the outside air. This would make the temperature of maximum draught in any chimney about 600° Fahrenheit. Experiments upon chimneys of ordinary proportion show, nevertheless, that the draught is stronger, and that more coal is burned per square foot of grate, when the temperature rises above 600°."

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The *Boston Herald*, referring to Fall River, says: "The prosperity of the cotton mills of this city during the last six months of this year and during the entire year is without parallel in the history of Fall River manufacturing. Never was there a six months when the dividends paid to stockholders equaled those just paid, nor a year when so great a per cent. of the capital went into share owners' pockets."

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Speaking of Dr. Joule, Sir William Thomson recently said: "Both in electricity and mechanical action he laid the foundation of the great development of thermo-dynamics, which would be looked upon in future generations as the crowning scientific work of the present century. It is not all due to Joule, but he achieved one of the very greatest monuments of scientific work in the present century."

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Several recent attempts to wreck railroad trains suggests that more severe punishment should be meted out to such offenders, whether they succeed in their purpose or not. Of all cowardly crimes, train wrecking is the worst. An attempt at, if clearly proven, should put the offender behind bars for life, without the possibility of pardon.

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The project of connecting Berlin with the Baltic, by means of a ship canal, is again seriously advocated in Germany.

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The building of a system of underground railways in Paris is again being agitated.

## Practical Drawing.

BY J. G. A. MEYER.

NINETY-FIRST PAPER.

646. Fig. 522*a* represents the same cylinder as has been shown in Fig. 521*b*, last paper. In Fig. 522*a* the pyramid is assumed to be removed, enabling us to see the opening in the cylinder made by passing the pyramid through it, the axis of the opening being perpendicular to the vertical plane of projection. But in order to enable us to explain the method for finding the outline of this opening, we have indicated the position of the pyramid by dotted lines.

The curves $a_9\ b_9$, $c_9\ d_9$, $a_9\ f_9$, and $d_9\ e_9$ can be found with the aid of the plan shown in Fig. 522, but for finding the curve $b_9\ k_3\ c_9$ and $f_9\ k_5\ e_9$ we need the elevation shown in Fig. 522*b*; in this figure we have shown only as much as will be needed for our explanation; indeed, if a draftsman is requested to draw only an elevation such as is given in Fig. 522*a*, his auxiliary elevation in Fig. 522*b* will simply consist of a line representing the edge through $c$, and the elements $k\ k_3$, $l\ l_3$ of the cylinder (see Fig. 521*a*, last paper,) drawn at the correct distance from the vertex of the pyramid; of course, the line representing the lateral edge through $c$ must be drawn at the proper height above the base of the cylinder, otherwise it is useless.

It may also be mentioned that when we have to draw an elevation only like that shown in Fig. 522*a*, it will be more convenient to draw the plan directly under the required elevation, as shown in the illustrations.

Assuming now that the outlines of the cylinder and pyramids have been drawn as shown in Figs. 522 and 522*a*, the outline of the opening in Fig. 522*a* may be found in the following manner:

647. Divide the line $c_7\ d_7$ (Fig. 522) into any number of equal parts, say four, and through the points of division 1, 2, 3 draw lines to the vertex $v_7$. Also divide the line $c_2\ d_2$ (Fig. 522) into the same number of equal parts, namely, four, and through the points of division $1m$, $2m$, $3m$, draw lines to the vertex $v_2$. These lines intersect the cylindrical surface in the points $1n$, $2n$, $3n$, also in the points $1r$, $2r$, $3r$. Through the point $n$, in which edge $c_2\ v_2$ cuts the cylindrical surface, draw a vertical line cutting the line $c_7\ v_7$ (Fig. 522*a*) in the point $c_9$; again through the points $1n$, $2n$, $3n$, and $4n$ draw vertical lines cutting the lines $1\ v_7$, $2\ v_7$, $3\ v_7$ and $d_7\ v_7$ respectively in the points $1s$, $2s$, $3s$ and $d_9$; join these points by a curve, which will be the curve in which the lateral face ($v_2\ c_2\ d_2$, $v_7\ c_7\ d_7$) of the pyramid intersects the cylindrical surface. The curves of intersection $d_9\ e_9$, $a_9\ f_9$, and $a_9\ b_9$ are found in a manner precisely similar to the foregoing.

648. To find the curves $b_9\ k_3\ c_9$, and $f_9\ k_5\ e_9$ we proceed as follows:

Let us consider the curve $b_9\ k_3\ c_9$ only. The extremities $b_9$ and $c_9$ of this curve have already been established. To find the point $k_3$ on the line $k_7\ k_9$ we simply make the distance between the points $v_7$ and $k_3$ equal to the vertical distance between the points $c_5$ and the line through $d$ in Fig. 522*b*, or, what amounts to the same thing, through $c_5$ draw a horizontal line cutting $k_7\ k_9$ in the point $k_3$, which is the highest point in the curve. For finding any other point in this curve we may adopt the following method:

Through the vertex $v_7$ (Fig. 522*a*) draw any straight line $v_7\ t_7$ intersecting the line $b_7\ c_7$ in the point $t_7$; through this point draw a vertical line cutting the line $a_2\ d_2$ (Fig. 522) in the point $t_2$, and through the point $t_2$ draw a line to the vertex $c_2$ cutting the circumference of the circle $i_2\ l_2\ h_2\ k_2$ in the points $t$ and $t_4$. Through the point $t$ draw a vertical line cutting the diameter $i_2\ h_2$ in the point $u_2$. In Fig. 522*b* make $h\ t$ equal to $u_2\ t$, and through the point $t$ draw a vertical line cutting the line through $c$ in the point $t_5$, and through this point draw a horizontal line cutting $t_7\ c_7$ (Fig. 522*a*) in the point $t_9$; this point will be another point in the required curve; in a similar manner we may find as many points as we please; the curve joining these points will be the required curve of intersection. The curve $f_9\ k_5\ e_9$ is found in a similar way; further explanation is unnecessary. The curve $b_9\ k_3\ c_9$ will be a portion of an ellipse, but it will coincide very nearly with the arc of a circle; consequently for ordinary drawings we simply find the highest point $k_3$, and join the points $b_9$, $k_3$ and $c_9$ by an arc of a circle.

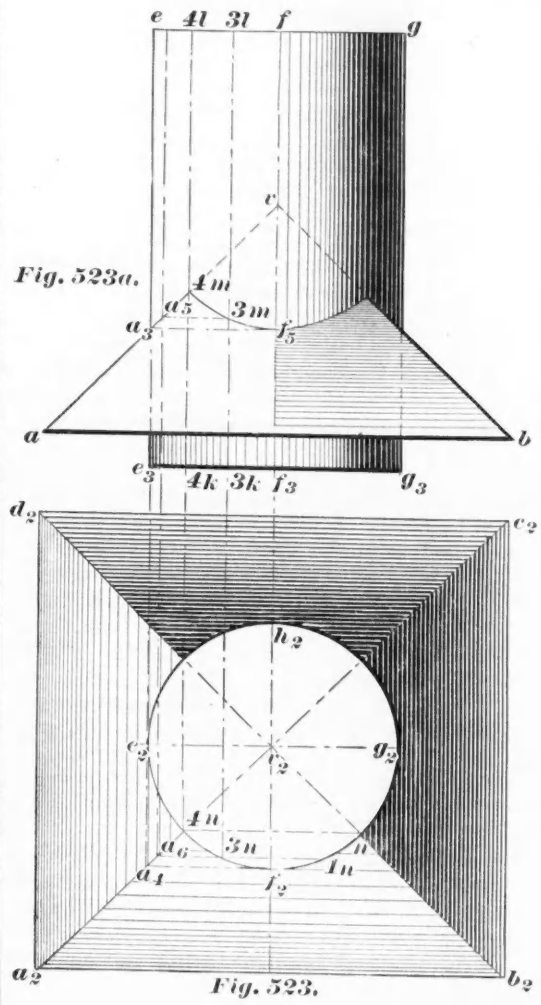

Fig. 523.

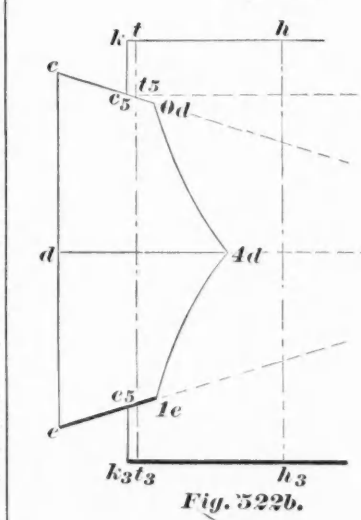

Fig. 522b.

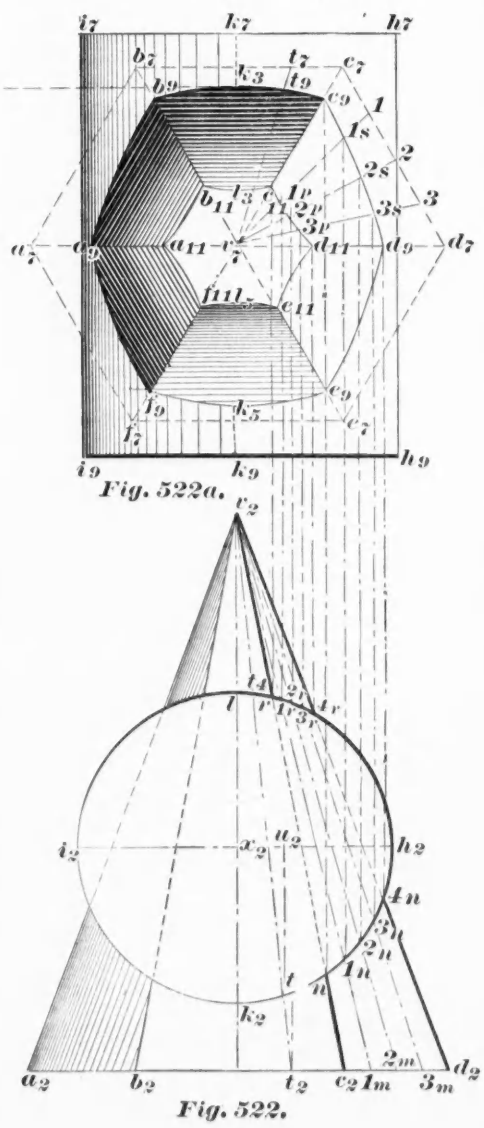

Fig. 522a. Fig. 522.

It may also be remarked, that if the points $b_9$ and $c_9$ have been correctly determined by the construction here given, then a horizontal line through the point $O\ d$ (Fig. 522*b*) must pass through the points $b_9$, $c_9$; otherwise the construction is not correct.

The curves $b_{11}\ c_{11}$, $c_{11}\ d_{11}$, etc., make up the projection of the small end of the opening. The illustration plainly shows the manner of finding the curve $c_{11}\ d_{11}$, the curves $d_{11}\ e_{11}$, $a_{11}\ f_{11}$, and $a_{11}\ b_{11}$ are found in a similar way. The extremities $b_{11}$ and $c_{11}$ of the curve $b_{11}\ l_3\ c_{11}$ will be established by finding the curves just referred to, hence to draw the curve $b_{11}\ l_3\ c_{11}$ we need to find only one more point in it, namely, the point $l_3$. This point is found by making $l_3\ c_7$ equal to the vertical distance between the line $d\ v$ and the point $c_7$ in Fig. 521*a* (last paper); the arc of a circle drawn through the points $b_{11}$, $l_3$ and $c_{11}$ will be approximately the curve required; we say, approximately, because the curve $b_{11}\ l_3\ c_{11}$ will be a portion of an ellipse instead of an arc of a circle, but the difference will be so small as to be scarcely perceptible. The same remarks apply to the curve $f_{11}\ l_5\ e_{11}$.

The correctness of the construction may be proved by assuming that the lines $1\ v_7$, $2\ v_7$, etc., are the intersections of auxiliary cutting planes with the lateral face ($v_7\ c_7\ d_7$, $v_2\ c_2\ d_2$), and then follow the same course of reasoning as given in connection with the last problem. But we can also prove the correctness of the construction in another fashion, which may appear to be a simpler one to the beginner. Thus, for instance, we may consider the line $1\ v_7$ (Fig. 522*a*) to be the vertical, and $1m\ v_2$ (Fig. 522) the horizontal projection of an independent line. Fig. 522 plainly indicates that this line pierces the cylindrical surface in the point $1n$, and also in the point $1r$; the vertical projection of the point $1n$ must lie in the line $1\ v_7$ (Fig. 522*a*) and also in a vertical drawn through the point $1n$; hence $1s$ is the vertical, and $1n$ the horizontal projection of the point in which the line ($1m\ v_2$, $1\ v_7$) pierces the cylindrical surface. But this line lies on the lateral face of the pyramid, hence the point in which it pierces the cylindrical surface must be a point in the curve in which lateral face intersects the cylindrical surface; the same course of reasoning applies to the other points found.

*Directions.*—On a separate piece of drawing paper draw an elevation and plan of a cylinder and pyramid as shown in Figs. 522*a* and 522. The dimensions of the cylinder and pyramid to be the same as given in the last paper; find the outline of the opening. Use a scale of 6 inches to the foot. It will also be good practice to draw on the same sheet a complete elevation, such as is shown in Fig. 521*a*, and then find the intersections in that elevation without drawing a plan directly underneath it, but taking all the required distances from the plan drawn under the elevation, as given in this paper.

*Problem* 108.

649. *Intersection of cylinder with pyramid; the axis of the cylinder and that of the pyramid lie in one straight line.*

Let $e\ g\ e_3\ g_3$ (Fig. 523*a*) be the vertical, and $e_2\ g_2\ h_2\ f_2$ (Fig. 523) the horizontal projection of a cylinder; and $c\ a\ b$ the vertical, and $c_2\ a_2\ b_2\ c_2\ d_2$ the horizontal projection of a pyramid; the cylinder is passed through the pyramid, the axis of the former and the axis of the latter lie in one straight line; it is required to find the intersections.

Let us first find the curve in which the lateral face ($c\ a\ b$, $c_2\ a_2\ b_2$) of the pyramid intersects the cylindrical surface.

The horizontal projection of this curve is the arc $4n\ f_2\ n$, extending from the line $c_2\ a_2$ to the line $c_2\ b_2$ (Fig. 523). Through $c_2$ draw a vertical line $f_2\ f$, cutting the circumference of the circle in the points $f_2$ and $h_2$. Divide the arc $f_2\ n_4$ into any number of equal parts. For the sake of simplicity and clearness we have divided it into two parts only; for practical purposes it is better to divide it into a greater number of equal parts. Through the point of division $3n$ draw a vertical line $3n\ 3l$; again through the point $3n$ draw a horizontal line terminating in the point $a_6$ in the edge $c_2\ a_2$; through the point $a_6$ draw a vertical line cutting the line $c\ a$ in the point $a_5$, and through $a_5$ draw a horizontal line cutting the line $3l\ 3n$ in the point $3m$; this point will be a point in the required curve. Through the point $a_3$ (Fig. 523*a*) in which the line $c\ e_3$ cuts the line $e\ a$, draw a horizontal line cutting $f\ f_2$ in the point $f_5$, which will be the lowest point in the curve of intersection. Lastly, through the point $4n$ (Fig. 523) draw a vertical line cutting $c\ a$ in the point $4m$; this will be the highest point in the curve. In a similar way find points on the right-hand side of the line $f\ f_2$; join the points $4m$, $3m$, $f_5$, etc., by a curve; this curve is the required intersection, which in Fig. 523 is represented by the arc $4n\ f_5\ n$. The principles on which this construction is based will readily be perceived. For instance, in Fig. 523 we see that the cylindrical surface cuts the edge $c_2\ a_2$ in the point $4n$; the vertical projection must, of course, lie in the line $c\ a$; and since the horizontal and vertical projection of a point must lie in one vertical line, it follows that the point $4m$ in which the vertical through $4n$ cuts the line $c\ a$ must be a point in the curve. Now let us consider the manner in which we have found the point $3m$. Here we assume that a cutting plane perpendicular to the horizontal plane of projection is passed through the cylinder and pyramid. This cutting plane will intersect the cylindrical surface in two elements, represented in Fig. 522 by the points $3n$ and $1n$; the vertical projection of the element through $3n$ is represented by the line $3l\ 3k$ (Fig. 523*a*). The same cutting plane will also intersect the lateral face $c_2\ a_2\ b_2$ of the pyramid in a horizontal line drawn through the point $3n$, the intersection terminating in the edges $c_2\ a_2$ and $c_2\ b_2$; the point $a_5$ (Fig. 523*a*) in which the vertical through $a_5$ cuts the line $c\ a$ will be the vertical projection of one extremity of the line in which the cutting plane intersects this lateral face. Now because, in Fig. 523, the horizontal line through $a_6$ is parallel to the line $a_2\ b_2$, and both lie in the same face, it follows that the line of intersection through $a_5$ (Fig. 523*a*) must be parallel to $a\ b$, hence the horizontal line drawn through $a_5$, and terminating in the lines $c\ a$ and $c\ b$, will be the vertical projection of the line in which the cutting plane intersects the lateral face of the pyramid. And since the cutting plane contains the horizontal through $a_5$, and also the element represented by the line $3l\ 3k$, it follows that the point $3m$, in which these lines cut each other, must be a point in the curve. Any number of points between $4m$ and $f_5$ may be found in this way.

It will also be readily perceived that in this particular case the portion $e\ a_3$ of the element $e\ e_3$ must be equal to $f\ f_5$ of the element $f\ f_3$, therefore the point $f_5$ in which the horizontal through $a_3$ cuts $f\ f_3$ must be the lowest point in the curve of intersection.

*Directions.*—In space marked Problem 108, draw the vertical and horizontal projection of a cylinder and pyramid as shown in Figs. 522*a* and 522. Diameter of cylinder, $5\frac{1}{2}$ inches; height, 10 inches; altitude of pyramid, 5 inches; base, 10 inches square. Find the intersections. Use 3-inch scale.

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## Showing up the New Cruisers.

The United States has started out a "squadron of evolution," consisting of four of the vessels that have been built in the way of creating something that may be called a navy. These four vessels—the Chicago, Boston, Atlanta and Yorktown, are not likely to create much sensation in Europe, where they go into such matters on a gigantic scale, but it is the opinion of those entitled to judge, that even there they will be looked upon as very creditable jobs, and it has yet to be settled whether they are not better than some of the enormous ironclads owned by European Governments. Just now the drift of opinion is in the direction that these great monsters will—in the unfortunate event of war—be fought by other means than by matching against them ships of their own type, and that the war ships of the future will be comparatively light, swift cruisers. If it proves true, as many think, that the day of the great ironclads is gone, then it is fortunate that the government did not begin building a navy ten years earlier, when the start might have been made on something not wanted. However, the "United States squadron of evolution" is looked upon in Europe, the construction is likely to be criticized, and from that something may be learned.

While this squadron is in practice, the contractors will be at work on three 2,000 ton cruisers, and the government is in the market for two 1,000 ton gunboats. Thus it will be seen that the work of getting a navy is steadily progressing. The fact that there is no difficulty in building any kind of vessels required ought to give an impulse to shipbuilding in this country. There is lack neither of skill, ability nor material.

## The Link Again.

The *Railroad Gazette* recently devoted considerable spleen, more than two columns of space, two indicator diagrams of the kind usually employed for the purpose, and some ingenuity in piecing statements together out of place, in an attempt to bolster up its argument against the compression brought about in locomotive cylinders by the use of the link motion ordinarily employed. It would not be worth while giving more attention to the subject—particularly as the *Gazette* writer contrives to turn a fairly complete somersault before he is through with his alleged "discussion"—but for the fact that he asks for information, and shows lack of comprehension, in which he ought to be set straight.

First, after feeling constrained to explain that the link is the best device he knows of for distributing steam in the instance of the locomotive, he has the following in reference to a recent article in the AMERICAN MACHINIST, entitled "Anything to Beat the Link." The middle paragraph is ours:

"A surprising statement for a journal which lays much stress on its treatment of shop practice and stationary engine topics is the following, from the same column as the preceding:

"'It may be remarked, however, that the most remarkable examples of smooth and *cool* running high-speed engines are those in which high compression is employed; and cool running is the best evidence in the world of the absence of undue friction.'

"That this is contrary to the facts can be seen by reading a description of the action of the Straight Line engine in the columns of our contemporary, in which that remarkably smooth-running engine is said to have a constant compression rather small in amount and a variable lead, for the purpose of steadying the motion of the engine at varying cut-offs. This is not the only example of most satisfactory and smooth-running engines having small compression."

If the writer of the above can read straight he knows we did not say, in regard to the engine to which he refers, that compression is "rather small in amount." Moreover, if he can read indicator diagrams he knows that compression is very nearly up to initial pressure in one of the diagrams shown with the description to which he refers, and that in the instance of the other, compression is supplemented by lead until the pressure on the return stroke continues to rise until it quite equals initial pressure.

There is no reason why this engine should not run smoothly. It seems, however, necessary to say, for the benefit of our critic, that the engine that has given the reputation for smooth running to the Straight Line, is one in which compression is varied pretty much as it is varied in the locomotive.

The independent exhaust-valve Straight Line engine, to which he refers, and which we described in our issue of May 2, is intended for larger sizes, and we presume it will acquire as high a reputation for smooth and cool running as the single-valve Straight Line, but it will hardly do better. If it does better it will be by virtue of having more compression at ordinary points of cut-off. So much for this writer's knowledge of engineering matters and "surprising statement."

We said in a previous article, "The *Gazette* writer puts aside the opinions of some of the best known investigators of this subject (compression in the locomotive) in the country," and, in a doubting way, he inquires who these writers are.

At the time of writing we had in mind Mr. Charles T. Porter and Mr. Charles E. Emery. Neither of these engineers, it will probably be admitted, is accustomed to speak without proper investigation, and they have both put themselves on record, in the most unmistakable manner, in favor of the compression brought about by the link at high speed.

Of the indicator cards shown in our contemporary, as absolutely no data are given except the speed in miles per hour in the instance of one of them, nothing can be said, except that the card from the link motion engine is not a representative card, such as can be had from a well-designed passenger locomotive at fifty-five miles per hour. This will be apparent to any one who has an elementary knowledge of the subject.

Answering at once several other questions which the writer referred to propounds, we have no doubt that, when locomotive builders are convinced that their boilers are too large for their cylinders at high speeds, they will provide port area sufficient to take care of all the steam the boilers will make, without seriously disturbing the bugbear of compression, or providing cylinders larger than are necessary for starting trains and getting them under way, the fear of which is evidently what is worrying him unless *something* beats the link.

Finally, this writer, who has been so worried in mind over the loss of economy from compression, gets pretty squarely on both sides of the fence at the same time (he begins his article by hedging), as follows:

"If the reduction of compression in a locomotive cylinder will give to that locomotive more power, and enable it to haul heavier trains according to schedule time, would it not be advisable, and even desirable, to sacrifice a little economy for a considerable increase in power?"

This has the advantage of giving him both sides of the question, and leaves nothing more to be said.

## Honest by Compulsion.

Workingmen as well as those who are not workingmen sometimes get into debt, and, we regret to say, are sometimes rather slow in paying their debts—just like other people. But General Superintendent Murphy, of the Erie road, has evidently made up his mind to have none but strictly honest men in the employ of that road. At least we suppose that is the object of an order which he has recently promulgated, requiring all employes to pay their debts; under which order, we understand, several shop men were recently suspended until their creditors certified that arrangements satisfactory to themselves had been made. At first thought it would seem that this would result in making all Erie men strictly honest, at least, in regard to paying debts. But can a man who does as honest men do, not from choice, but because some one else compels him to do so, be properly given the credit of being honest? When everybody knows that all Erie employes are compelled, by the superintendent's orders, to be honest and pay their debts, how is any one to know that there is a man on the road who is naturally honest and inclined to pay his debts?

And then the question naturally arises. Will not the honest men who are naturally inclined to pay their debts prefer to work where the conditions are such that they can get the credit for being honest? The laws of the several States in which the Erie has men employed, and the common law, define the condition under which society considers it to be necessary or expedient to interfere between debtor and creditor. Business men leave these matters to the honor of those concerned, and finally to the law, for settlement. We think the Erie road and all other roads should do precisely the same thing.

We hope that all Erie employes, as well as all other employes, will keep out of debt so far as possible. We hope that those who are so unfortunate as to fall in debt will be both able and willing when the time comes to discharge their obligations. But we think that the road, in undertaking to look after the business of the retail merchants and boarding-house keepers along its line, is not only doing something which its charter gives it no authority to do, but is discrediting its honest employes, and paving the way to a condition of things in which there is liable to be much more trouble of the kind it seeks to prevent than where these things are left to take the course society prescribes for them.

## Literary Notes.

A Treatise on Steam Boilers: Their Strength, Construction, and Economical Working. By Robert Wilson, C. E., Late Inspector for the Manchester Steam Users Association, etc. Enlarged from the Fifth English Edition by J. J. Flather, Ph.B., Instructor of Mechanical Engineering, Lehigh University, etc. New York: John Wiley & Sons.

Wilson's work on steam boilers has become standard amongst practical men, both here and in England. The author does not claim to give new facts, which probably makes the work all the more valuable. He says of his book:

Any claim to attention it may deserve is based upon its being an attempt to embody the principles of boiler construction and management, together with numerous opinions collected from the writer's experience in boiler inspection, and from various other sources not accessible to the majority of those engaged or otherwise interested in the application of steam.

The foregoing quite clearly defines the scope of the work.

The original work has been slightly altered from the original by the American author, the better, as he says, to suit it to American practice, and with Mr. Wilson's permission.

In addition to the body of the work, which covers more especially the subjects mentioned in the title, there is an appendix which contains a good deal of matter relating to riveting, calking, braces, boiler explosions, boiler attachments and steam-making appliances, code of rules for boiler tests, etc. The work is very complete, and one that can be recommended. The price is $2.50.

Now that the Paris Exposition is closed, and exhibitors have withdrawn their exhibits, they will very naturally sit down and compare the cost with the advantages gained. We have no doubt that for the most part the comparison will be satisfactory. International fairs like the Paris Exposition afford an opportunity to manufacturers not only for exhibiting what they are doing in a way hardly possible by other means, but as well to see what others are doing. The immediate advantages are not likely to be as marked as those that will follow later on. A great many exhibitors at Paris established business relations likely to be profitable, and considerable business was done in the way of immediate sales.

There is little reason to doubt that these great exhibitions are excellent as educators, and the more countries represented, and the more varied the exhibits, the more valuable they are in this respect. Therefore it is much to be desired that every effort be used to bring foreign exhibitors to this country in 1892, or at such time as the fair is held. It

ought, in substantial matters, to be greater than any fair that has preceded it, and doubtless will be if properly managed. But there is a great deal in the matter besides fine buildings.

## QUESTIONS AND ANSWERS

*Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.*

*Every question, to insure any attention, must invariably be accompanied by the writer's name and address If so requested, neither name, correct initials nor location will be published.*

(443) W. T., Perry, N. Y., asks: Can you give us measurements and general directions for working a blast gauge for our cupola? *A.*—See answer to Question 239, in our issue of May 28th, 1887. In this answer you will find an illustration of the gauge.

(444) Slide Valve, Sherbrooke, P. Q., writes: A. and B. discuss the slide valve; A. asks B. why a valve has inside lap? B. says it is for the purpose of making the valve ride easy. I do not know myself. Please explain. *A.*—Inside lap will not affect the riding of the valve; inside lap is for the purpose of delaying the release of steam; that is to say, open the exhaust at a later period of the stroke. Experience and good jdugment are necessary for determining the proper amout of inside lap; in high-speed engines it is not generally used.

(445) W.C. M., Lincoln, Neb., writes: Please give me a method by which I can galvanize small castings so that solder can be made to adhere to them. They will weigh about one-half pound each. *A.*—Cleanse the castings in an ordinary chafing mill, when the sand is all removed take them out and heat one by one, plunging, while hot, in a liquid composed as follows: 10 pounds hydrochloric acid, and sufficient sheet zinc to make a saturated solution. In making this solution, when the evolution of gas has ceased, add muriate, or, preferably, sulphate of ammonia, one pound, and let it stand until dissolved. The castings should be so hot that, when dipped into this solution and instantly removed, they will immediately dry, leaving the surface crystallized, like frostwork on a window pane. Next plunge them, while hot, but perfectly dry, into a bath of melted zinc, previously skimming the oxide on the surface away, and throwing thereon a small amount of powdered sal-ammoniac. If the articles are very small, enclose them in wrought-iron basket on a pole, and lower them into the metal. When this is done, shake off the superfluous metal, and cast into a vessel of water to prevent them from adhering when the zinc solidifies.

(446) Reader, Hartford, Conn., writes: I have frequently seen a vacuum gauge in connection with steam gauge on ferryboats. What does the vacuum gauge register? and where is the so-called vacuum? and why is it desirable that it should be known? *A.*—After the steam has done its work in the cylinder, it is exhausted into the condenser, where it is condensed, and the resulting water and vapor is drawn out of the condenser by means of an air-pump, creating a partial vacuum in the condenser. The nearer perfect the vacuum becomes, the less will be the resistance, due to the atmospheric pressure, which the steam pressure will have to overcome. If there is a perfect vacuum in the condenser, the resistance which the steam pressure on the piston will have to overcome will be reduced nearly 15 pounds per square inch. A perfect vacuum cannot be obtained, but engineers endeavor to obtain a condition in the condenser as near to a perfect vacuum as is consistent with the economy of fuel, or, in other words, endeavor to reduce the pressure in the condenser as much as possible, and this pressure in the condenser can only be ascertained by the indications of the vacuum gauge. Since the partial vacuum in the condenser depends on the working of the air-pump, it follows that the vacuum gauge also indicates whether the air-pump is working properly or not. If the air-pump should cease to act, the condenser may become flooded, which may lead to serious accidents, hence the necessity of the vacuum gauge will be perceived.

(447) Guelph, ———, asks: What amount of water is necessary per hour to condense the steam from a 100 horse-power compound condensing engine running on 20 pounds of steam per horse-power per hour? The water is taken from a river; its temperature is 60 degrees. Please give formula. *A.*—Since the temperature of the injection water will vary, and since temperature of the steam as it flows into the condenser may also vary, an allowance of 27 to 30 pounds of water per pound of steam is often made. If we adopt the latter figure, we will need $20 \times 30 = 600$ pounds of water per horse-power per hour, and $600 \times 100 = 60{,}000$ pounds of water for 100 horse-power per hour. This quantity of water is considerably greater than would be required if the temperatures of the injection water and steam did not vary. To obtain in a more exact way the quantity of water required, the following formula is used

$$\frac{(1{,}114 + 0.3\,t) - t_2}{t_3 - t_2} = Q,$$

in which $t$ is the temperature of the steam corresponding to a pressure indicated by the vacuum gauge in degrees Fahrenheit; $t_2$, the temperature of the injection water; $t_3$, the temperature of the hot well, and $Q$, the number of pounds of water required to condense one pound of steam. Assuming the temperature $t$ of the steam to be 193°, and the temperature $t_3$ of the hot well 120°, and the temperature $t_2$ of the injection water is 60°, as given in the example, and substituting these values for the symbols given in the formula, we have

$$\frac{(1.114 + 0.3 \times 193°) - 120°}{120° - 60°} = Q = \frac{1{,}051.9}{60} = 17.53$$

pounds of water for every pound of steam to be condensed. And $17.53 \times 20 = 350.6$ pounds of water per horse-power per hour, giving $350.6 \times 100 = 35{,}060$ pounds of water per 100 horse-power per hour. 2. What size of pipe will be necessary to carry this amount of water 350 feet, raising it 13 feet by suction? *A.*—Pipe 4 inches diameter.

## BUSINESS SPECIALS

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.*


Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc., J. B. Roney, Lynn, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells, & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Prestoline & Prestoline Paste, for cleaning & polishing metals. S. A. Smith, 23 S. Canal st., Chicago.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Iron Planers from 16" to 36" wide by any length. H. C. Pease & Co., Worcester, Mass.

Patent Attorney. R. G. DuBois, 715 11th st., Wash., D. C., procures first-class patents for inventors.

Adjustable Shrinkage Gauges. Pedrick & Ayer, Philadelphia, Pa.

Link Milling and Slotting Machine. Pedrick & Ayer, Philadelphia, Pa.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

The hook on steam engines is being supplanted by the Dill disconnecting device made by the T. C. Dill Machine Company, 726 Girard ave., Phila., Pa.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Nov. 14, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Solid Bolt Dies, V, U. S. S., Whitworth, Square and Left-Hand Threads in stock. S. W. Card & Co. Mansfield, Mass.

25" 28" 32" 36" Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Standard Reducing Valve, Standard Pump Pressure Regulators, Improved Collignon Cylinder Oil Pumps, Jenkins Globe and Angle Valves. Send for circulars. Standard Regulator Co., 70 Elm st., Buffalo, N. Y.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages. Illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller.
Propellers of same pattern and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices.
Consulting Expert and Constructing Engineer.
Estimates made on machinery and on damages.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

Patterson, Gottfried & Hunter (Lim.), 146-150 Centre st., N. Y., carry a complete stock of Brush, Copper, Celluvert Fiber, Oiled Paper, Hard Rubber, Rod & Sheet Brass, Brass, Copper & Iron Wire, Self-Hardening Tool Steel, Set & Cap Screws, Machine Bolts, Machine & Wood Screws, Taps & Dies, Files and Twist Drills, Blowers & Forges, Machinery, Tools & Hardware, Gear Wheels, Wood Pulleys, Shafting, Hangers & Belting. General factory supplies.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 105 articles have thus far appeared up to and including the November 28, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Dec. 5, 1889 issue, 91 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

C. H. De Lamater & Co. have closed their extensive manufactory at the foot of West 13th street, New York, and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.

In order to close out the remainder of the stock, offer for sale a very desirable lot of machinery, such as lathes from 15" to 88" swing, planing machines 48"x45"x10', 53"x50"x12', 17"x14"x24', 72"x69"x24', and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers and two 8"x16" and one 10"x20" Rider cut-off engines.


## MANUFACTURES

The Paterson (La.) Sash, Door and Blind Co. has been organized.

The John R. Davis Lumber Co., of Phillips, Wis., will build a new planing mill.

The Carrol-Porter Boiler Tank Company, Pittsburgh, Pa., will build a shop, 100x300 feet.

The Anderson Tannery and Shoe Factory Company has been organized at Anderson, S. C.

The Egan Company, Cincinnati, Ohio, will erect an addition to their works, 80x180 feet.

Sidebottom & Walton, of Philadelphia, Pa., contemplate the erection of a cotton goods factory at Anniston, Ala.

The Concordia Cotton and Fiber Company has been incorporated at Fort Payne, Ala., by H. D. Capers and others.

H. W. Fairbanks is organizing a company at Dallas, Texas, to build a mill for the manufacture of ginghams and checks.

The Otis Manufacturing Co., of New Orleans, La., whose saw-mill was recently destroyed by fire, have decided to rebuild at once.

The York Spoke and Handle Co. has been incorporated at Yorkville, N. C., to manufacture wagon materials, handles and agricultural implements.

A large water-power on the falls near Port Arthur, Ont., is to be utilized for manufacturing purposes. It is calculated that 200,000 horse-power is available.

The Whitman Agricultural Works, of Winthrop, Me., makers of agricultural tools, will remove to Auburn, Me. They have their new factory nearly completed.

Schlosser & Son, Defiance, Ohio, have received from the city five acres of land upon which to build a wagon factory, and are now putting up a building, 100x200 feet, with an L 150 feet.

The National Hardwood Door Co., Chicago, Ill., has been incorporated by D. M. Swiney, E. E. Swiney and J. J. Hock, with a capital stock of $50,000, to manufacture and sell hardwood doors.

The Embree-McLean Carriage Company, recently incorporated in St. Louis, with a capital stock of $50,000, for the manufacture of fine vehicles, have their new building on Olive street well under way.

The Orono Pulp and Paper Co., which has organized with a capital of $250,000, has purchased twelve acres of land at Bazin Mills, near Bangor, Me., and will erect a pulp mill of the daily capacity of ten tons.

The Commercial Knitting Company, of Brunswick, N. Y., was incorporated this week, with a capital of $50,000. The trustees are: Ferdinand M. Aufsesser, Gates Barnet, William Barnet and Jonas M. Barnet.

The Snow Steam Pump Co. has been organized at Buffalo, N.Y., and will manufacture and sell pumps, castings and pipes, and other mechanical appliances. The capital stock is fixed at $100,000, divided into 1,000 shares.

The Sweetwater Shoe Factory, at Florence, Ala., has become an alliance factory, and the stock will be raised from $25,000 to $100,000. A large tannery will be run in connection with the factory, sufficient to supply its demand.

The New Haven Clock Company, 29 Murray street, N. Y., have issued a catalogue illustrating and describing their electrical department. Electric clocks, gongs, alarms, etc., for a great variety of purposes are illustrated.

Robert Logan & Son will build a $10,000 brick plant at McKeesport, Pa., to manufacture brick from stone. The plant will be operated with gas, and will employ twenty-five men, and have an output of 15,000 brick per day.

Albert Fisher, for some years in the machinery business at Cleveland, Ohio, has opened an office at 89 Liberty street, New York, where he will represent the John T. Noye Manufacturing Co. in the sale of their steam engines.

According to the Philadelphia *Ledger*, a Mr. Edward J. Dorlan has invented a machine for making tin fruit cans, by the use of which ten men can make from 40,000 to 60,000 cans per day. No solder enters the interior of the can.

The citizens of Dadeville, Ala., in conjunction with the Farmers' Alliance, have organized a company for the building of a cotton mill. Thos. Barrow, E. H. Langley, Thos. L. Burger and O. P. Sanford are among the incorporators.

J. F. Hart & Bro. are to build a large saw-mill at Tacoma, Wash. It will have a double circular, a band, and a 52-inch gang. The mill will be located on Commencement Bay. A woodenware factory will be started in conjunction with it.

The Watervliet Arsenal is being put in shape for doing a large amount of work. Contracts have been awarded Gould & Eberhardt, Newark, N.J., to supply the arsenal with four drill presses and an automatic gear cutter with rack attachment.

We learn, by announcement, the members comprising the firm of E. E. Garvin & Co., New York, have transferred all their interests in the business to the Garvin Machine Co. The new firm assumes all debts, and will continue business as usual.

The Union Switch and Signal Co., of Pittsburgh, Pa., has made a 92 lever machine for the Grand Central Depot, New York, and is at work upon the largest electro-pneumatic signaling and interlocking table yet constructed, for the Union Depot at Kansas City, Mo.

The contract has been let to the City Water Company, of Chattanooga, Tenn., to erect a stand pipe and supply historic Lookout Mountain with 3,000,000 gallons of water daily from the Tennessee River, 260 feet below. The contract is to be completed by April 1, and the cost of the improvements will be $50,000.

The factories now building at Auburn, Me., to be occupied by Packard & Briggs, Moses Crafts, Smith's Paper Box Factory, and the Fitz Last Factory, are to be run by one plant. The power will be furnished by a 75 horse-power engine supplied by two boilers, one of 100 and the other 60 horse-power.

The Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, will open an Eastern house in New York on January 1st, 1890, under the management of W. H. Harrison, late with E. P. Bullard. They have taken 64 Cortlandt street, and will occupy four floors. They will proceed at once to remodel the entire building.

The Federal Steel Company has been incorporated in Illinois with a capital of $12,000,000. It is said that about thirty firms engaged in the manufacture of wire and wire rods have agreed to enter the company, accepting stock in lieu of their plants. It is stated that the objects of consolidation are similar to those which led to the formation of the Illinois Steel Company. Economy in production and distribution are to be gained, so it is said.

The two new brick factory buildings of the building association at Beverly [Mass.] are now nearly completed, and will be ready for occupancy Dec. 1. Each is 110x38 feet, and four stories high. The space between the two structures is 49 feet, in which is located the one-story boiler and engine house, and a brick chimney 85 feet high. It is proposed to rent the buildings, with power and heat included, at a reasonable rate. Each structure will be provided with fine offices, a general office of about 13x20 feet, and a private one of about 9x13. The two buildings are so planned that by a connection a structure can be had of 269x38 feet.—*Manufacturers' Gazette.*

Messrs. Hussey, Binns & Co., the well-known shovel manufacturers, of this city [Pittsburgh, Pa.,] will remove their plant to Jeannette some time next summer. The plans for the new buildings are about prepared. These buildings will be three in number, and built of brick and stone, with corrugated iron roofs. The size of the buildings will be 200x80, 225x90 and 275x90, and will reduce the danger of fire to a fraction. The company has for a long time felt the need of more room for their works, and, as there was no chance to enlarge at their present location, they decided to go outside of the city. Another great inducement is the lower rate of taxation and cheap gas fuel; their property being adjacent to the Grapeville belt, they are assured of a gas supply for a number of years, as one pound pressure is sufficient to run their place, but would not carry the gas to the city. As their busy season will continue until late in the spring, they, of course, do not wish to make the change until the rush is over, and so are able to move slowly in the matter, and thus have the new plant as near satisfactory as deliberate action will secure. This company recently made two shipments to New Zealand, and now have on their books a fair-sized order from Costa Rica.—*American Manufacturer.*

## Machinists' Supplies and Iron.

NEW YORK, NOV. 30, 1889.

Iron—American Pig.—Very little business is being transacted, except in the filling of old contracts, and prices for 1890 are not yet determined. Little unsold stock is to be found, and what there is, is held at fancy prices. No. 1 X Foundry brings $19 to $20; No. 2, $18 to $19.

# ✲WANTED✲

*"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.*

Competent agents wanted to represent a meritorious & paying steam specialty. Business, AM. MACH.

Wanted—Position as foreman of machine shop. Exp'd in gen'l work. Refs. Box 55, AM. MACH.

Pattern maker and machinist wishes to change. 1st-class refs. Wm. Sturrock, Woodhaven, L. I.

Draftsman and machinist wants position as draftsman or ass't sup't. Wright, care AM. MACHINIST.

Wanted—Position as engineer; have had charge of a steam plant for several years. Thoroughly competent. Best refs. Box 40, AMERICAN MACHINIST.

Wanted—Foreman boiler works who can manage about 25 men and get out good work at lowest cost. Address A. J. P., AMERICAN MACHINIST.

Correspondence desired with reliable concern in need of foreman for getting out automatic and st'y engines in quantities. Ref. Box 54, AM. MACH.

Foreman and contractor wanted, who can handle men and do good work promptly. Address Steam Engine, care AMERICAN MACHINIST.

Wanted—Draftsman that understands traction engine and saw-mill work. Address Ritchie & Dyer Co., Hamilton, Ohio.

Wanted—Good agents to sell on commission the Combination Pump and Heater. See ad. with cut of the machine. D. E. Rice, Detroit, Mich.

Wanted—Practical foreman, good mechanic, for manufacturing drills, reamers, taps and small tools. Address Box 40, Chester, Pa.

Position wanted by machinist and tool maker of nearly 20 years' experience on first-class work; several years as foreman. A good general mechanic. Address H. E. S., Box 1,574, New Haven, Ct.

Machinists Wanted—Vise hands accustomed to first-class work Steady employm't and liberal wages guaranteed. Have largely increased our plant and need more men. Niles Tool Works, Hamilton, O.

Wanted Young man who has had some experience with steam pumps (also steam engines) for salesman in office, etc. State experience and salary. Box 56, AMERICAN MACHINIST.

Wanted—Competent traveling salesman to represent our engineering specialties and brass work, for plumbers and steam fitters. State experience, and whether salary or commission. Box 57, AM. MACH.

Wanted—An exp'd traveling salesman, accustomed to handling specialties, and well known to the engine builders and trade throughout the country, is open for engagement Jan. 1st. Satisfactory refs. Address Box 52, care AMERICAN MACHINIST.

Wanted—A first-class foreman for small foundry. Must understand casting brass castings. Foundry in first-class shape; heated by steam. Address, with ref. and price per day (for the right man a permanent position can be obtained), E. K. Hayes, Galva, Ill.

Wanted—A competent foreman for mach. works; must be skilled in general designing, construction and iron work, and thoroughly accustomed to the handling of men, together with executive ability. The best refs. given and expected. State wages wanted, and address Foreman, AMERICAN MACHINIST.

Wanted—A thoroughly competent and experienced man to take charge, as superintendent, of a general foundry and machine shop employing from 150 to 200 men, in one of the best towns of 20,000 inhabitants in the West. Must be a good disciplinarian, and thoroughly familiar with the most modern machine shop practice, and capable of taking full charge of all departments of the business. First-class references required. Address Hill, Clarke & Co., 156 Oliver st., Boston, Mass.

## ✢ MISCELLANEOUS WANTS ✢

*Advertisements will be inserted under this head at 35 cents per line, each insertion.*

⅜" Portable Drill, $100. Am. Tool W'ks., Clev. O.

Koopman's Scales for quick measurements.

Glass Triangles. F. E. Harthan, Worcester, Mass.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

D. J. Kelsey, M. E., Designer of Automatic Machinery, 31 Insurance Building, New Haven, Conn.

Wanted—Patents of merit to manufacture and introduce. Box 46, AMERICAN MACHINIST.

Wanted—Light mach. work and spec. to manufac., on contract. Electric Mfg. Co., Greenbush, N. Y.

Small foundry and machine shop for sale. A good thing cheap. Address L. W. Shafer, York, Pa.

Wanted—A 2nd-hand steam hammer, 500 to 700 lbs. Address Hammer, AMERICAN MACHINIST.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O Box 1262, Phila., Pa.

Boiler maker with tools and capital would like to hear of a location for boiler shop. Address C. G., AMERICAN MACHINIST.

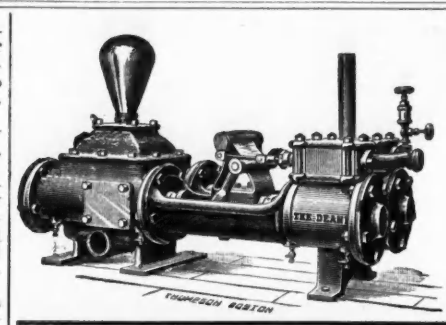
For Sale—One Jones & Lamson No. 8 Turret Screw Machine. Very little used. Cleveland Motor Co., 241 Center st., New York.

For Sale—An established mach. business, protected by valuable patents. Can be much enlarged by judicious management. C. M. W., AM. MACHINIST.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

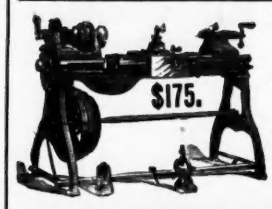
How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—Live business man to buy interest in machine business mfg. specialties now being sold throughout U. S. Good business opportunity for right man. Address Central, care AM. MACHINIST.

THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

"CRESCENT EXTRA"
Is now used by many of the largest and most carefully managed shops for all **Lathe and Planer Tools, Punches, Dies, Taps, Reamers, &c.**
This steel is famous for its uniformity and great endurance, and should be specified by Machinists and Tool-makers who want the best stock for their tools.
CRESCENT STEEL WORKS,
CHICAGO, ILLS. PITTSBURGH, PA. NEW YORK, N. Y




Improved Screw Cutting Foot and Power LATHES
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
THE SEBASTIAN-MAY CO., 167 W. 2d St.,
CINCINNATI, O.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

TOBIN BRONZE
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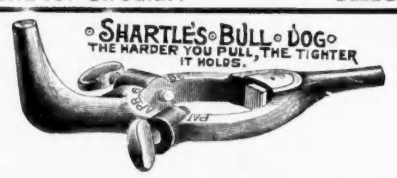


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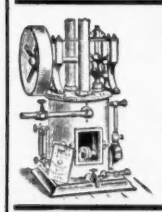

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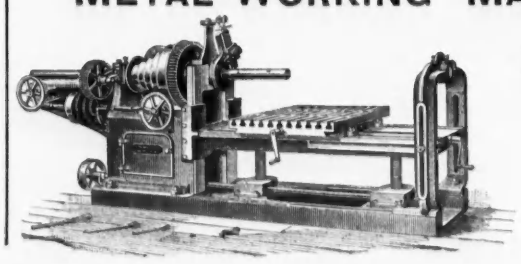

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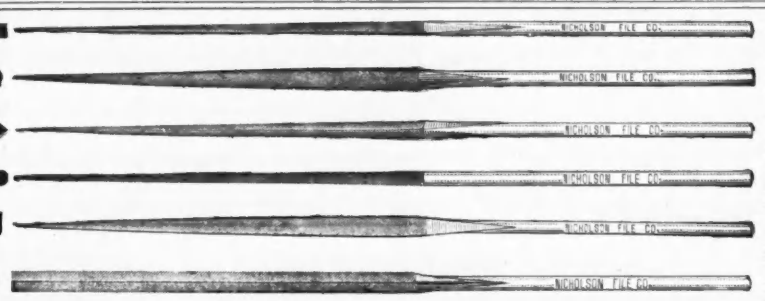


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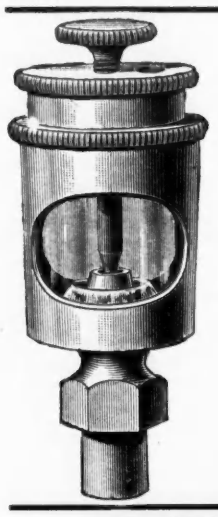

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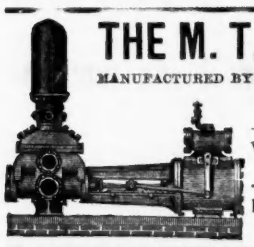

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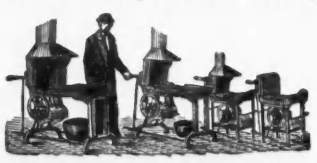

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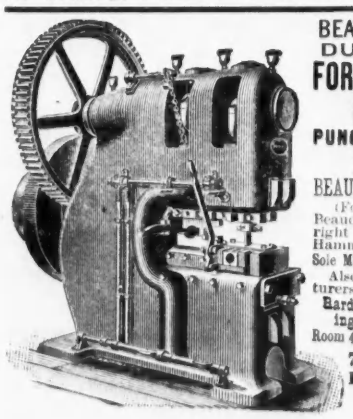

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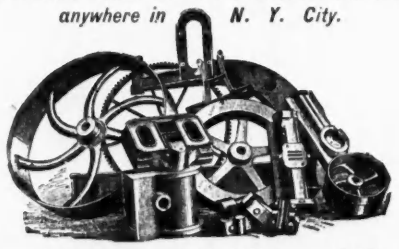

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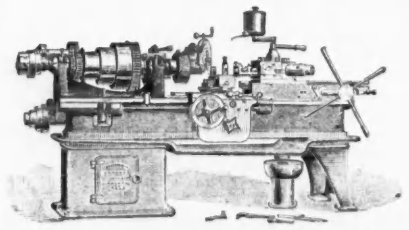

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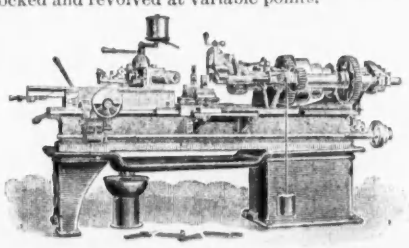

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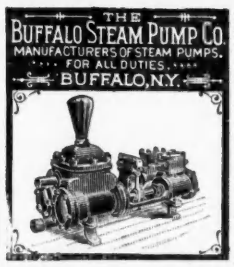


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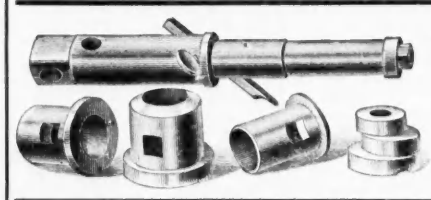

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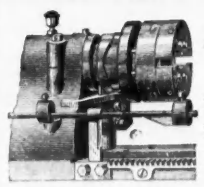

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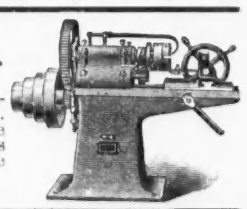

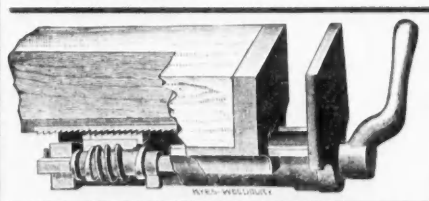

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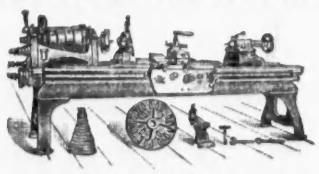

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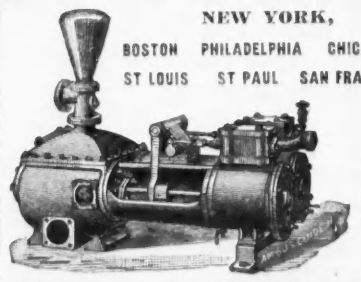

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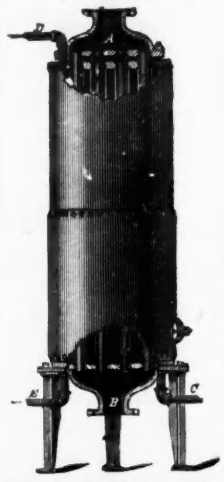

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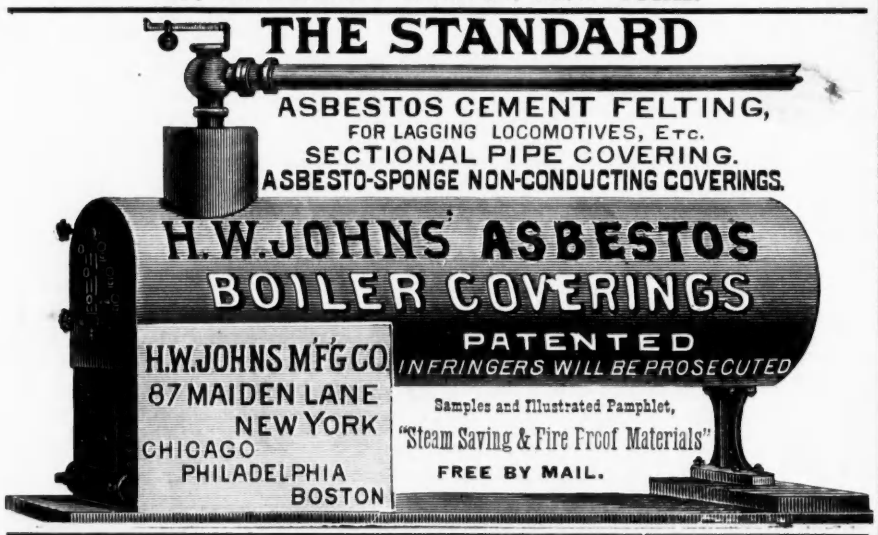


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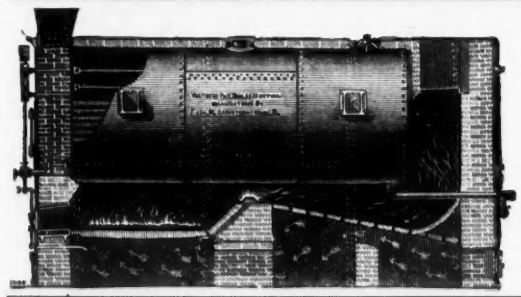

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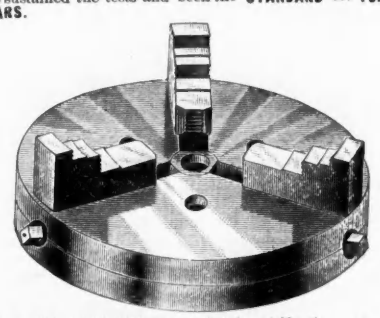

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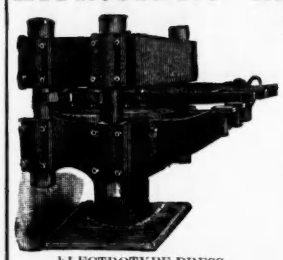

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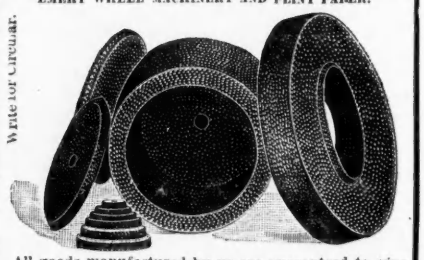

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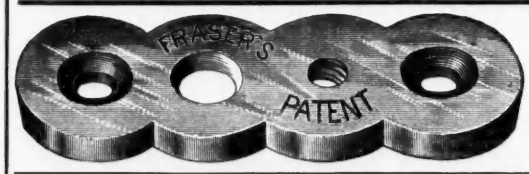


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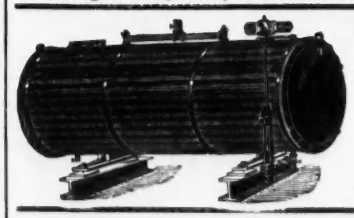

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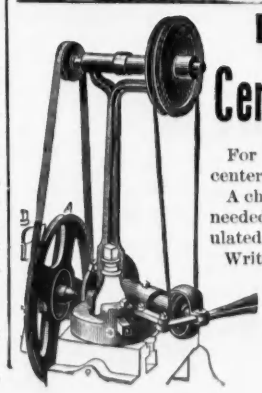

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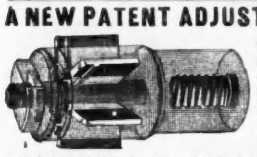

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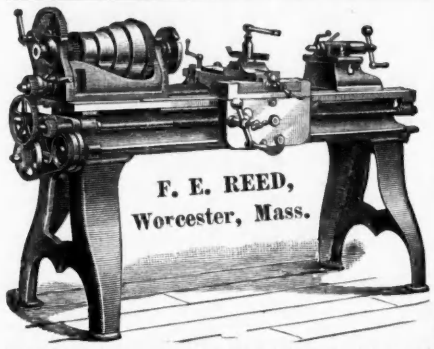


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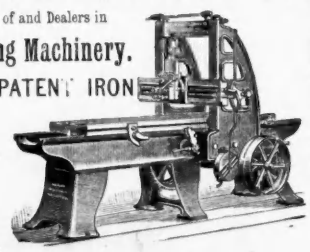

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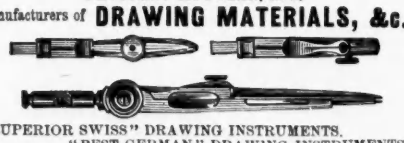

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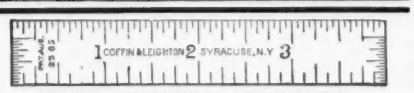


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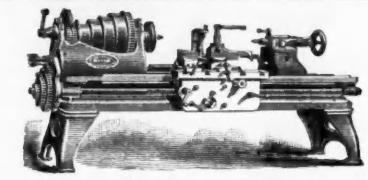

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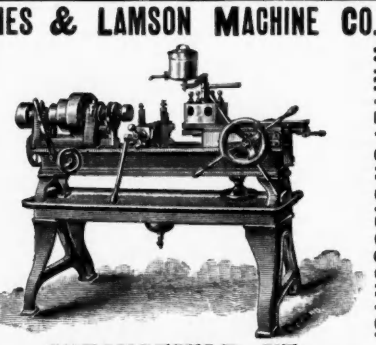

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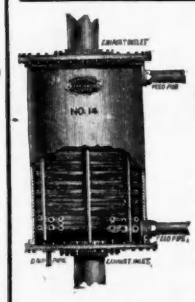

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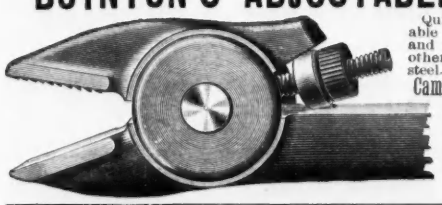

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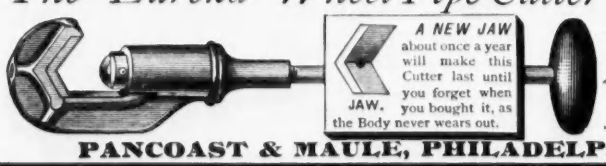


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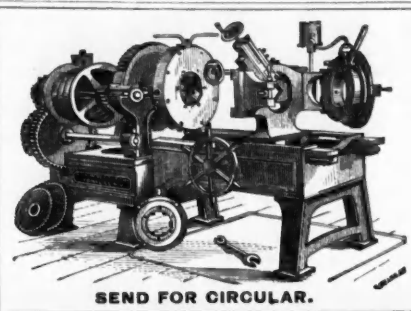

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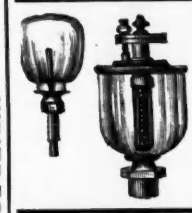

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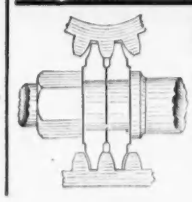

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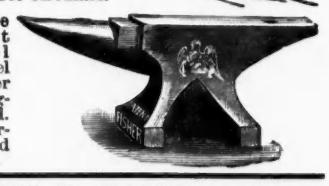

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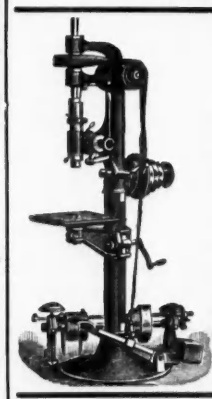

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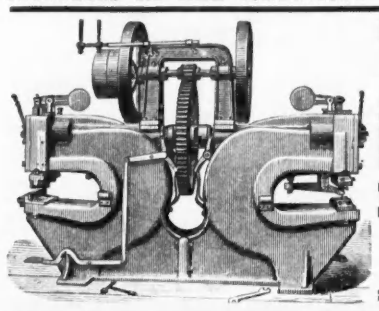

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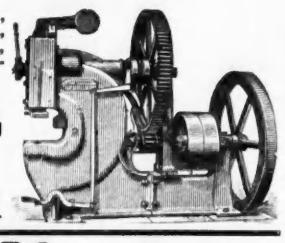

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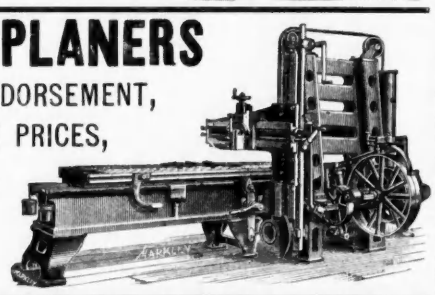

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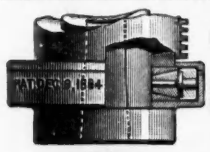

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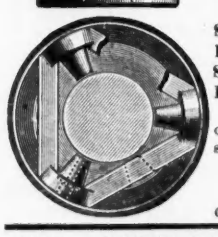

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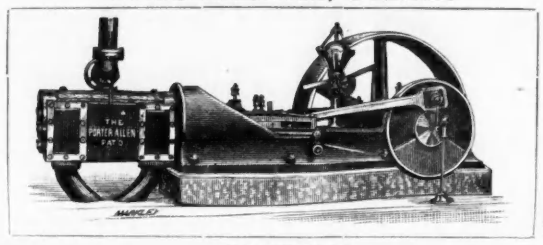

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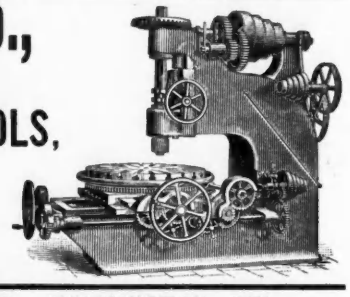

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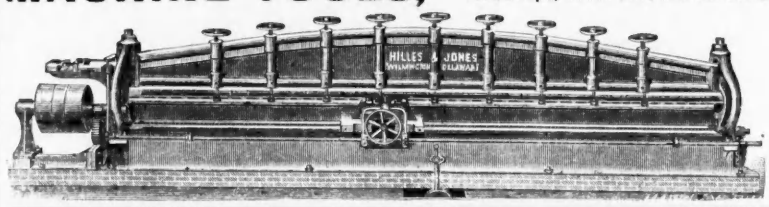

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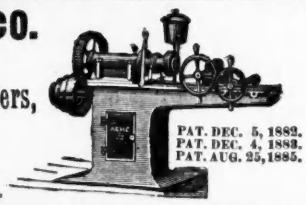

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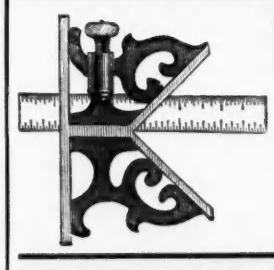

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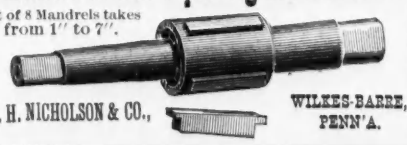

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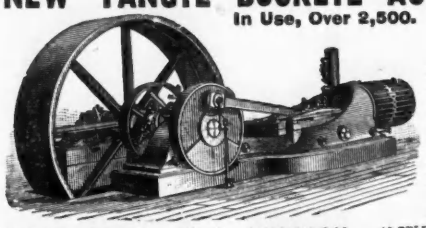

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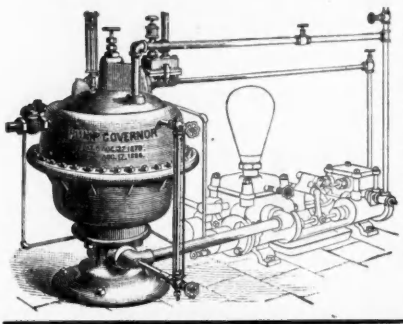

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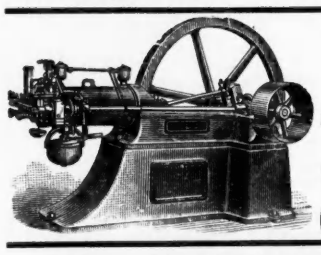

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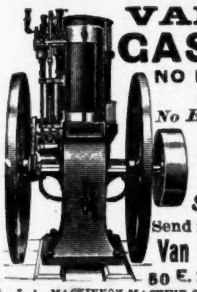

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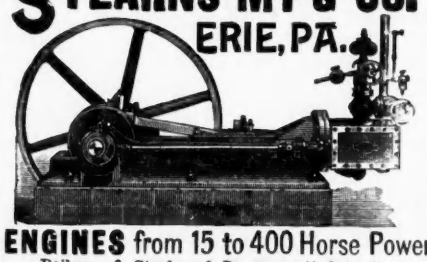

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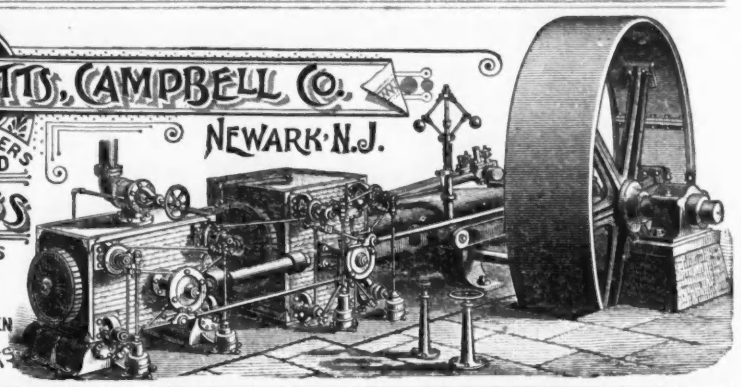

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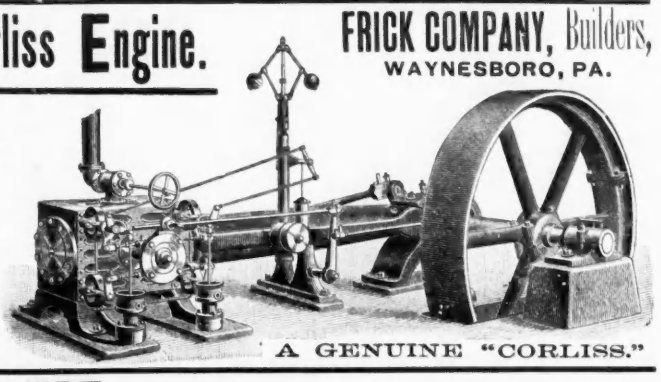

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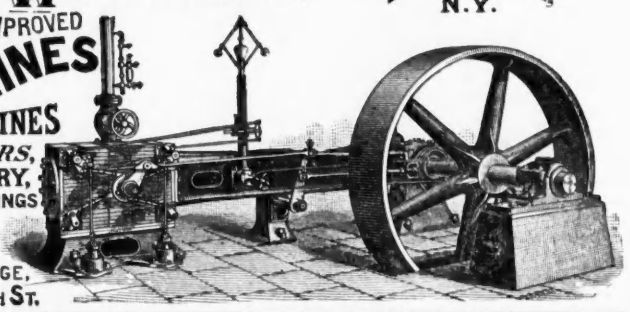

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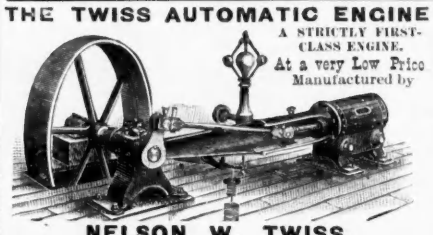

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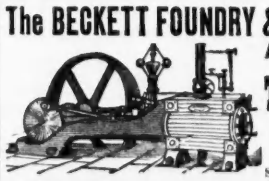

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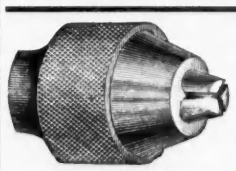

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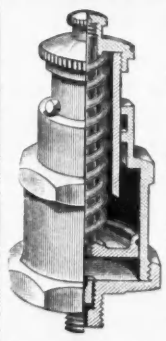

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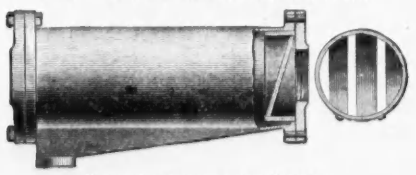

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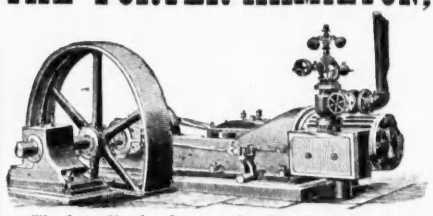

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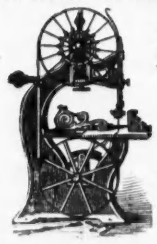

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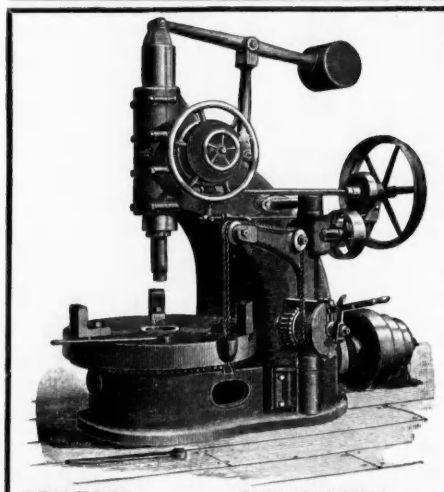

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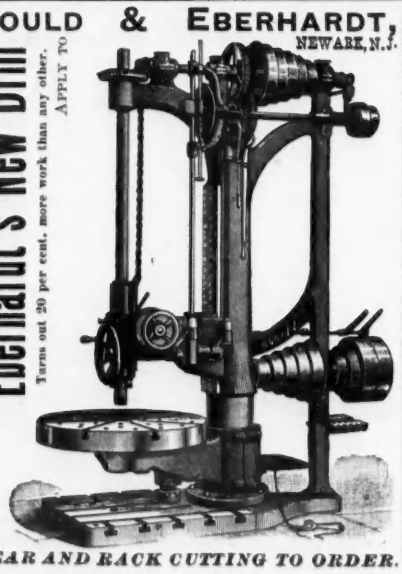

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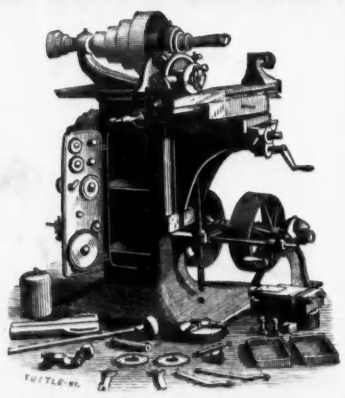

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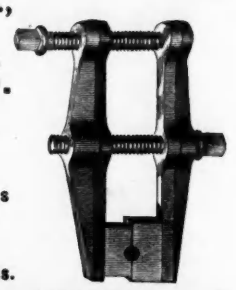

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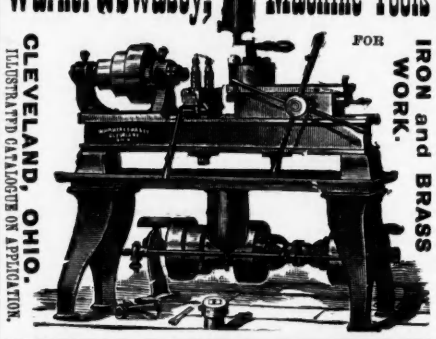

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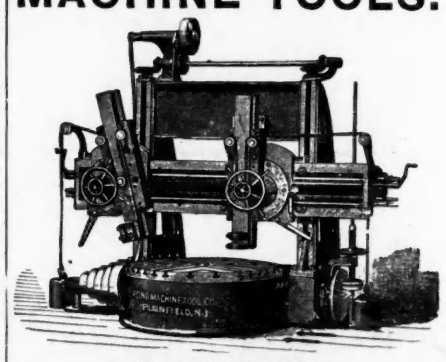

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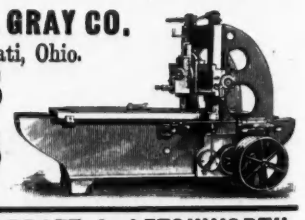

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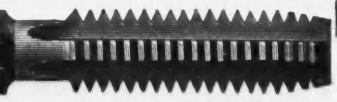

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